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What Price Air Conditioning?

By L. J. Verbarg*

Wide adoption of air conditioning makes consideration of factors for determining most suitable system essential

A DECISION as to the type and style of air conditioning apparatus best suited for railway cars operating under the diverse conditions found on our many railways is of increasing importance as the number of such trains is increased.

Due to the fact that air conditioning of railway cars is in the development stage, most existing installations have been made without proper regard to operating efficiency, the chief aim being to get the cars into service without delay to meet some competitive condition. Insufficient consideration has been given to the refrigerant used, efficiencies of motors, compressors, condensers, etc., design of air ducts, or whether duct or bulkhead distribution of air is more desirable.

Most purchases of air-conditioning equipment have been made on the claims of manufacturers as to performance of their equipment, because of the lack of facilities or reliable data with which to check these claims. The selection and application of equipment in this manner may be fairly satisfactory when only a few cars are to be air conditioned, but as the number of cars increases this procedure does not give the desired result. Eventually the operating and maintenance cost as well as performance is sure to be checked and the engineer charged with the design and installation of air-conditioning equipment will be wise to analyze the problems carefully before equipment is purchased and installed and to make recommendations according to the facts developed in his analysis.

Most cars being air conditioned today were built before manufactured weather became a reality, and to change their construction to provide adequate insulation would increase the cost of the installation to a prohibitive amount; therefore, the engineer must take the car "as is" and in some way find space for the equipment and provide sufficient refrigerating capacity to overcome the lack of insulation.

Air conditioning is defined as the complete control of temperature, humidity, motion and cleanliness of air within an enclosure, regardless of outside conditions. Therefore, it is necessary to provide apparatus that will add heat when desired in the cold season and abstract it during the warm season, also control the humidity, circulate and wash the air.

Four distinct temperatures are considered in air-conditioning calculations. *Dry-bulb temperature* needs no explanation as it is well understood as indicating heat intensity. *Wet-bulb temperature* is the temperature to which air will cool itself to the saturation point when undergoing a constant heat change in the presence of freely evaporating, non-cooled, non-heated water. The difference between dry and wet bulb is known as the "wet-bulb depression." *Dew point* is the temperature at which vapor begins to condense out of the air. The difference between dry bulb and dew point is known as the "dew-point depression." When air is saturated these three temperatures are the same, but as we depart from saturation both the wet-bulb depression and the dew-point depression increase. *Effective temperature* is a combination of temperature and humidity and is the temperature which affords the greatest degree of comfort to the human body.

The last important factor in air-condition calculations is humidity. Relative humidity is the ratio of moisture actually present in the air at its dry-bulb temperature to that which would be present if the air were saturated at its dry-bulb temperature. The relations between dry bulb, wet bulb and relative humidity have been plotted into curves known as psychrometric tables. If any two of these factors are known, the third may be ascertained from the tables.

The importance of humidity control is apparent by consulting the effective temperature chart, Fig. 1. This chart was prepared by the Harvard School of Public Health. It will be noted that the summer effective temperature ranges from 68 deg. F. at 70 per cent relative humidity to 85 deg. F. at 30 per cent relative humid-

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ity. While 85 deg. with 30 per cent relative humidity is regarded as comfortable, the same temperature with 70 per cent relative humidity is far outside the comfort zone. Winter effective temperatures range from 65 deg. F. at 70 per cent relative humidity to 79 deg. F. at 30 per cent relative humidity. Any temperature or humidity condition within these limits is regarded as being in the comfort zone. One set of temperature and relative humidity conditions will not, however, provide an equal degree of comfort for all persons. A summer effective temperature of 76 deg. is well within the comfort zone, yet it is often regarded as too warm by some of the traveling public, particularly those from a northern climate. It must be remembered that the adjustment of the human body from one temperature to another is a rather slow process; therefore, the temperature maintained in air-conditioning work must bear some relation to outside temperature conditions. The best we can strive for in the design of air-conditioned cars is the satisfaction of the majority of the traveling public.

Refrigerating Capacity Required

Experiments recently conducted indicate that to provide an interior effective temperature within the comfort zone it is necessary to remove heat from various classes of cars at the following rate:

	B.t.u. per hr.
Diners (capacity, 40 persons)	64,000 to 70,000
Lounge cars	65,000 to 80,000
Dining-lounge cars	65,000 to 70,000
Chair-coach	65,000 to 75,000

Using a modern steel diner as an example, the total amount of heat to be abstracted may be traced to the following sources:

		B.t.u. per hr.
1.	Heat infiltration through walls insulated with two-ply salamander	11,000
2.	From human bodies (40 people)	18,000
3.	From food	3,000
4.	From fresh air and dehumidification	24,000
5.	From solar radiation	10,000
6.	From fan motor	750
	Total	66,750

The above is based on an outside temperature of 90 deg. F. Any departure from this temperature will have a slight effect on items 1 and 4. Regarding item 2—heat from human bodies—the human body, like a partly wetted wet-bulb thermometer, does not react in direct relation to either a dry-bulb or a wet-bulb thermometer under normal conditions. When subjected to extreme temperature the regulatory system throws out perspiration to the extent that the saturation may become practically complete. The body, however, differs in one respect from the wet-bulb comparison in that it is internally heated. Food is converted by oxidation into energy which is utilized for external work or internal reconstruction. This process of metabolism is not 100 per cent efficient; therefore, waste heat is created and unless dissipated will cause body temperature to increase. It is a function of air-conditioning systems to absorb this waste heat at the rate it is dissipated from the body, which is about 450 B. t. u. per hr. for a person of average size. Having determined the total amount of heat to be abstracted per hour, it is necessary to divide this figure by 12,000 to obtain the refrigeration tonnage required.

Refrigerating machinery is rated in tons of refrigeration per 24-hr. period, but the temperature at which this refrigeration is produced is a vitally important factor in air-conditioning calculations. Fig. 2 shows the effect of temperature on the capacity of the refrigerating equipment.

Heat absorption by the evaporator is governed entirely by its temperature and the velocity of the air passing through it. This rate of heat absorption must always be equal to or below the capacity of the refrigerating unit to avoid overloading. The relative humidity obtainable inside the car with any type of refrigerating equipment depends largely upon the evaporator temperature, and to provide satisfactory humidity conditions the cooling coil or evaporator temperature must remain below the dew point. It is, therefore, apparent that a unit rated at 60 deg. F. might prove satisfactory when used in sections of the country that have consistently high dew points, but would be entirely inadequate to control the humidity where the dew point is consistently low.

Types of Refrigerating Equipments

There are three distinct types of refrigeration available and the final choice depends largely upon the conditions under which the car is to operate.

Many engineers advocate the natural ice system because of its simplicity, ease of installation, absence of chemical refrigerant and low first cost. These advantages are offset by the space requirements for ice bunkers, the necessity of providing icing facilities en

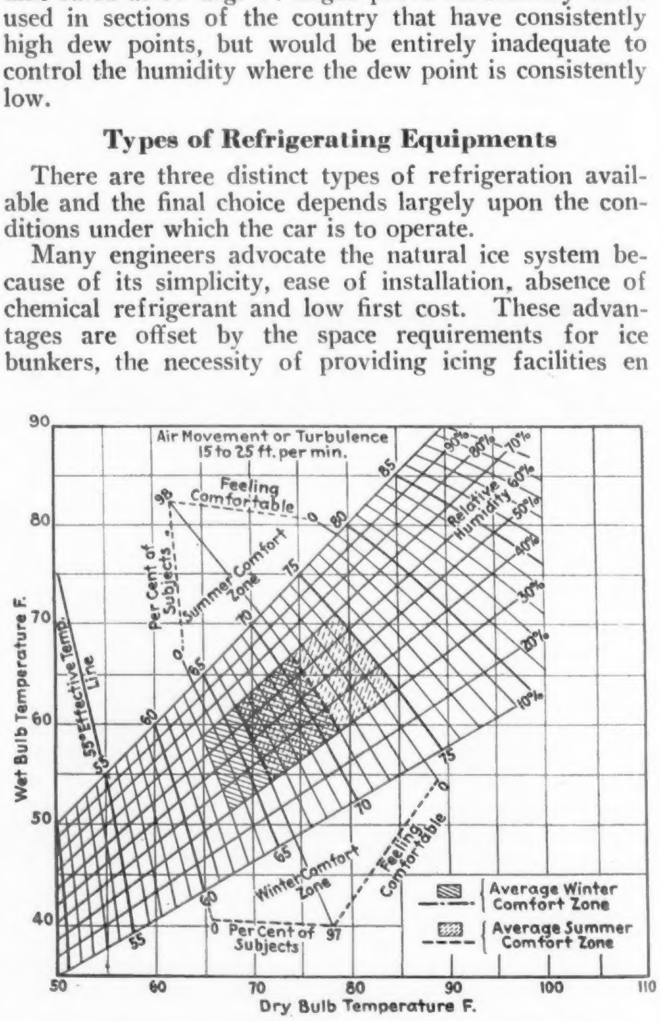


Fig. 1—Comfort or effective temperature chart

route if the car is assigned to a long run and a relatively high operating cost. Maintaining a refrigerating rate of six tons requires the melting of 500 lb. of ice per hour. As ice storage capacity is limited to a maximum of 4,500 lb. of ice per car, the time between icing would be nine hours at most. Based on an average speed of 40 m.p.h., the car would have to be re-iced every 360 miles and probably more often, as the refrigeration decreases as the amount of ice in the storage bunkers decreases.

At present a large percentage of air-conditioned cars are equipped with mechanical type refrigeration. The success of this type of equipment is a matter of power supply and rigid maintenance. The mechanical system falls into two classes, one having the compressor electrically driven and the other with the compressor mechanically driven direct from the car axle.

The compressor in the latter type is usually driven through a series of V-belts and the speed control is obtained by interposing a magnetic clutch in the drive shaft. With this equipment no refrigeration is available while the car is standing and only partial capacity is obtainable until the car reaches a speed of approximately 30 m.p.h.

A system of this type would be desirable only when the car is to be assigned to trains on which stops are infrequent and of short duration. Fig. 3 shows the temperature rise in a dining car after refrigeration has been discontinued. In addition to the rapid temperature rise water is re-evaporated off the cooling coils, thus raising the relative humidity inside the car enough to make it extremely uncomfortable after refrigeration has been discontinued 15 min. or longer. On equipment driven directly from the car axle an a. c. motor is provided to drive the compressor during precooling periods, but this source of power is seldom available during station stops and not at all during switching movements. The chief advantage claimed for this equipment is that it eliminates the necessity of providing large generators and high-capacity batteries.

With the electrically driven compressor type equipment refrigeration is available whether the car is moving, standing or being switched. Power is supplied from a 32-volt storage battery during station stops and switching movements, and an a. c. motor is provided to drive the compressor during precooling periods. Another advantage claimed for the electrically driven equipment is that it is independent of any source of power not contained on the car itself.

All makes of compressor-type refrigerating units are essentially alike, although they differ as to the size and number of cylinders, compressor speed, etc. Most equipments rely on air to cool the compressor and condense the refrigerant, although several manufacturers can supply water-cooled units if desired. Water-cooled equipment operates at lower head pressures than the air-cooled style and naturally less compressor power is required. This is offset by the power required to operate

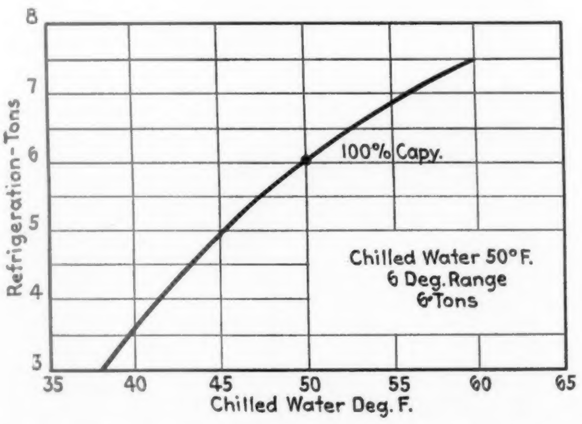


Fig. 2—**Effect of temperature on capacity of refrigerating equipment**

the water pump and cooling tower equipment and the fact that the water supply must be replenished frequently to compensate for loss by evaporation.

With most electrically driven equipments the compressor motor can be converted to a d. c. generator when the equipment is driven by the a. c. motor, and the current thus generated is available for the battery charging during the precooling period.

The third type of equipment available is the steam-jet or thermal compressor system, using water as a refrigerant and locomotive steam to produce the refrigerating effect. While this method of refrigeration has been used for more than 20 years, only recently has it become a commercial success on passenger-train cars. Artificial reduction of the pressure on water makes it boil at a point below the normal boiling point. If the air is exhausted from a vessel until the pressure is only 0.085 lb. per sq. in., water within the vessel will boil at 32 deg. F. In other words, the temperature at which water ordinarily freezes now becomes its boiling point. Steam-jet refrigeration uses this principle. The refrigerating chamber or evaporator is an air-tight metal container, about one-fifth of which is filled with water. The space above the water is evacuated until the pressure is less than 1 in. of mercury per sq. in. This evacuation is accomplished by a steam jet through which the steam rushes past an opening in the evaporator at a velocity of from 3,500 ft. to 4,500 ft. per sec. At the top of the evaporator is a horizontal pipe through which water is sprayed into it. Because of the extremely low pressure in the evaporator these sprays immediately flash into vapor. As the latent heat of evaporation at this pressure is approximately 1,060 B.t.u., the transformation of each pound of water into vapor requires this amount of heat. With no other source from which to obtain this heat other than the water in the bottom of the evaporator, this water is cooled to the temperature corresponding to the pressure maintained in the cooling chamber. The vapor is carried along by the steam jet and as it passes through the narrow throat of the jet is compressed. It then passes through the condenser, which is usually of the surface type. This condenser is generally cooled by the action of water sprays and air. After the water in the evaporator is chilled to the desired temperature, it is pumped through the cooling coil where its temperature is raised by the absorption of heat in the air passed over the coil. The water is then returned to the evaporator and the process repeated.

With cars so equipped it is necessary to have some external source of steam to operate the air-conditioning apparatus while cars are being pre-cooled at terminals. This constitutes a disadvantage, as in most terminals steam is not available during that season of the year when precooling is desirable. Also, no refrigeration is available during switching operations when the cars are disconnected from the locomotive.

Power Requirements

An investigation of power requirements for motor-driven compressor equipments now on the market reveals that there is little difference in the kilowatt input required per ton of refrigeration delivered. This input ranges from 2.01 kw. to 2.10 kw. per actual ton of refrigeration at 40 deg. evaporator temperature, the average being 2.06 kw.

Recent tests on two identical cars operating in the same territory—one equipped with a six-ton mechanical unit and the other with a six-ton steam-ejector unit—showed the following comparison of power required:

	Mechanical	Steam Ejector
Continuous input for refrigerating equipment, in kw.	8.4	3.1
Continuous input for battery recharging, in kw.	2.8	1.0
Average output of generator, in kw.	11.2	4.1
Generator efficiency	80 per cent	
Generator drive efficiency	90 per cent	
Locomotive mechanical efficiency	80 per cent	
Locomotive steam consumption, i.hp.hr.	20 lb.	
Time of train run	9 hr. 55 min.	
Time refrigeration required	9 hr. 55 min.	
Time generator in operation	7 hr. 27 min.	
Total generator output required	86.76 kw. hr.	30.69 kw. hr.
Total hp. input to locomotive cylinders	202 hp. hr.	71.5 hp. hr.
Average locomotive steam used per hr. of generator operation	542 lb.	192 lb.
Steam used by ejector, per hr.	...	200 lb.
Steam loss by condensation, per hr.	...	30 lb.
Total steam to cylinders	4,040 lb.	1,430 lb.
Avg. cylinder i.hp. per hr. of generator operation	27.1	9.6
Avg. steam used per hour of train run	408 lb.	374 lb.
Total steam used	4,040 lb.	3,709 lb.

When measured in terms of total steam consumption there is little difference in the amount of power required,

but it is evident that with the mechanical system all this power must be developed by the locomotive cylinders, while the majority of the power required for the steam-ejector system is furnished direct from the locomotive boiler. This fact is relatively unimportant when only one or two cars in a train are equipped, but the equipping of solid trains of ten or more cars with motor-driven compressor type equipments would impose such an additional load on the locomotive cylinders that it is doubtful whether present schedules could be maintained without reducing train tonnage. The additional load imposed on the locomotive cylinders by the mechanically equipped car under test was equivalent to the load which would have been imposed moving 36.2 train tons at 40 m.p.h. The additional cylinder load imposed by the steam-ejector system was equivalent to moving 12.85 tons at 40 m.p.h. The amount of steam required by the ejector is furnished direct from the locomotive boiler and is about the same amount of steam that is required to heat a car in zero weather.

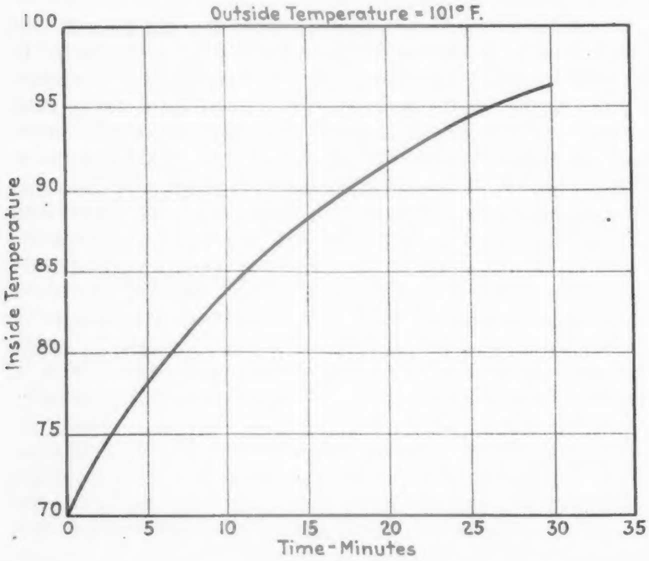


Fig. 3—Temperature rise after discontinuance of refrigeration

Refrigerants

All compressor type refrigerating units depend upon a manufactured chemical refrigerant for their refrigerating cycle. For general commercial refrigerating work ammonia is most widely employed, but carbon dioxide, sulphur dioxide, methyl-chloride, ethyl-chloride and several other special compounds have been used. All these refrigerants are more or less toxic, while some have a pungent odor and are decidedly distressing and damaging to the human organism. Because of the toxic qualities of the refrigerants mentioned none of them is suitable for use in air-conditioning systems, and it became necessary with the advent of air conditioning to develop a non-toxic refrigerant whose refrigerating cycle could be completed under ordinary temperatures and pressures. The result of this development was a gas known as dichlorodifluoromethane ($C\ Cl_2\ F_2$). This gas is commonly known as F-12 or Freon. Certain other derivatives of this gas have been obtained and are known as F-11 and F-114. Although these derivatives of F-12 are useful in absorption systems and small household units, F-12 is better adapted for use on railway cars. Although Freon is difficult to keep confined in a refrigerating system and its cost is high, nearly all manufacturers of air-conditioning apparatus now recommend its use.

Air Ducts

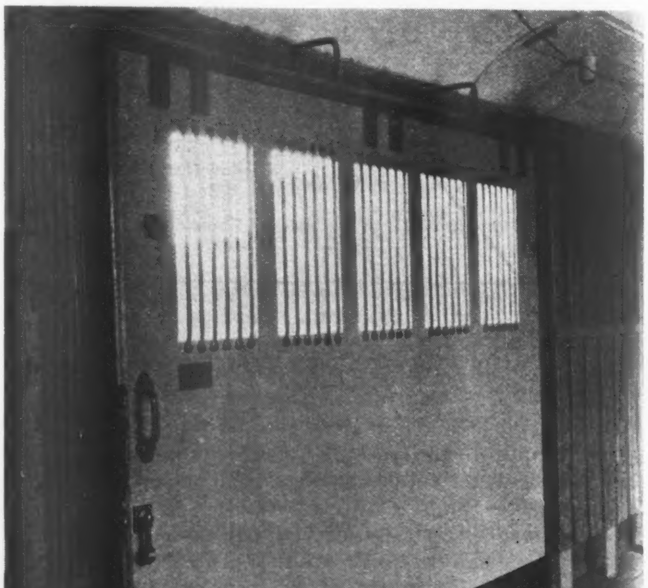
The design of air ducts is of great importance as their design affects the air distribution in the car and to some extent the outlet temperature of the chilled air. The ducts should be well insulated from solar radiation and also from the steel car roof. The use of aluminum foil for insulation of air ducts seems practical, as this form of insulation is light in weight, easy to apply and has an exceptionally high efficiency. Experiments are now being conducted to determine the effect of aluminum paint as a reflecting agent to reduce the heat from solar radiation.

Control Lockers

The ventilation of control lockers is of prime importance. The natural draft method used on ordinary car-lighting control lockers has proved inadequate to dissipate the heat generated by the control apparatus of air-conditioning equipment of the mechanical type, and lockers used for this purpose should be equipped with some type of forced ventilation.

Baggage Car Doors

THE accompanying illustration shows an installation of a Phemaloid Compound Lumber door in a baggage car. These doors, manufactured by the Haskelite Corporation, Chicago, were made from a single piece of Phemaloid lumber. Phemaloid is made of real wood, cross laminated for strength and glued with a phenolic resin adhesive which is said to be immune to moisture and bacteria growth—the principal causes of rot. The



Phemaloid compound lumber door as applied to Pere Marquette baggage car

particular installation shown was one of four car doors, two 8 ft. 1½-in. by 6 ft. 2¼-in. and two doors 6 ft. 1½-in. by 6 ft. 2¼-in. All four doors in this car were 1½-in. thick.

Locomotive Counterbalancing

By Lawford H. Fry

THE principles of the method and the results to be obtained are discussed in the body of the paper. This schedule is drawn up to present the detailed methods of computation to be followed in order to secure the results desired. Values corresponding to an actual locomotive are inserted for each item and the schedule is arranged so that if it is re-written with blank spaces for the values it can be used as a work sheet for computing any other example.

The notes at the end of each section define any special terms used and provide any necessary discussion of the methods.

The data as to weights and dimensions called for by the schedule must, of course, be obtained from the design of the locomotive.

Section I — To Find the Equivalent Weight and Plane of Action of the Rotating Parts in Each Wheel

The schedule given here is drawn to cover the main pair of driving wheels. It should be applied successively to each of the other pairs of drivers, dropping out the items which do not apply. This section of the schedule is illustrated by Figs. 5 and 6.

1. E = Distance in inches between central planes of right and left hand counterbalances ....62 in.
2. W_1 = Equivalent weight in pounds of crank pin hub together with part of pin encircled by hub............500 lb.
3. A = Distance in inches between centers of gravity of right and left hand crank pin hubs............71 in.
4. M_1 = Moment of crank pin hub parts about center plane of opposite counterbalance.
   $M_1 = W_1 \times (A + E) \div 2$............33,200 in./lb.
5. W_2 = Equivalent weight in pounds of side rod carried on crank pin* together with weight of part of crank pin encircled by side rod bearing............550 lb.
6. B = Distance in inches between center planes of side rods...77 in.
7. M_2 = Moment of side rod parts about center plane of opposite balance.
   $M_2 = W_2 \times (B + E) \div 2$............38,200 in./lb.
8. W_3 = Equivalent weight in pounds of back end of main rod* together with weight of part of crank pin encircled by main rod bearing............1,440 lb.
9. C = Distance in inches between center planes of main rods...85 in.
10. M_3 = Moment of main rod parts about center plane of opposite counterbalance.
    $M_3 = W_3 \times (C + E) \div 2$............106,000 in./lb.
11. W_t = Sum of all rotating equivalent weights, except those for eccentric cranks.
    W_t = Items (2 + 5 + 8) =
    $W_1 + W_2 + W_3$............2,490 lb.
12. M_t = Sum of all moments of rotating parts, except eccentric cranks, about center plane of opposite counterbalance.
    M_t = Items (4 + 7 + 10) =
    $M_1 + M_2 + M_3$............177,400 in./lb.
13. F = Distance in inches between center of gravity of all rotating parts, except eccentric cranks, and center plane of opposite counterbalance.
    F = Item 12 / Item 11
    $= M_t \div W_t$............71.3 in.

* See Notes on Section 1.

Notes on Section I

Item 2—To find the equivalent weight of the crank pin hub together with the part of the pin encircled by the hub, it is necessary to find the actual weight of these parts and their center of gravity. The weight to be taken into account is that of the cross-hatched area in Fig. 6 which lies outside the circumference of the axle hub. Then if

W = Actual weight of these parts in pounds.
R_1 = Distance in inches of their center of gravity from longitudinal axis of axle.
R = Radius of rotation of crank pin in inches.
W_1 = Equivalent weight of these parts
$$W_1 = W \times R_1/R$$

This is the Appendix to the author's A. S. M. E. paper which appeared in the February issue. It contains a schedule of simple computations by which the results set forth in the paper may be obtained

Equivalent Weight of any part rotating about the longitudinal center line of the axle is defined as the weight of that mass which rotating at the crank radius would produce the same inertia force as the actual mass under consideration. The above example shows how the equivalent weight is found when its actual weight and the radius of rotation of its center of gravity are known.

Item 5—The equivalent weight of the side rod carried on the crank pin is the actual weight supported by the pin. For the front and back drivers this is the weight of one end of one side rod. For the main and intermediate drivers it is the weight of one end of each of two rods. As the center of gravity of the side rod end

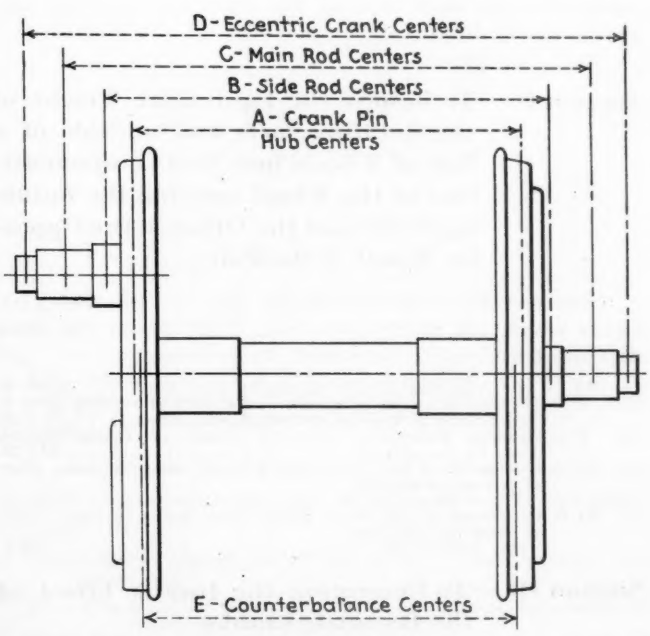


Fig. 5—Data for computation of effect of rotating parts

rotates with the same radius as the center of the crank pin, the equivalent weight of these parts is the same as their actual weight.

Item 8—The equivalent weight of the back end of the main rod to be used in this item can be taken as approximately six-tenths of the total weight of the main

rod. If strict accuracy is required the weight to be used can be found from the equation:

$$W_{m_2} = W_m \times k^2/l^2$$

where W_m = total weight of main rod in pounds.
l = length of rod in inches between wrist pin and main pin centers.
k = radius of gyration in inches of the main rod about the wrist pin center.
W_{m_2} = weight of main rod to be considered as rotating at the crank pin.

The radius of gyration *k* can be found by suspending the

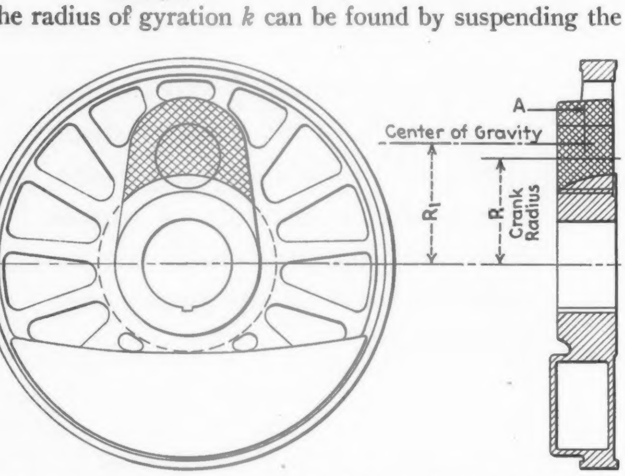


Fig. 6—Portion of crank-pin hub to be included in revolving weights

main rod to swing as a pendulum about the wrist pin center. Then if

k = distance in inches of the center of gravity of the rod from the wrist pin center

and

t = time of one swing in seconds
$k^2 = 3.26\ t^2k.$

If the radius of gyration *k* cannot be found experimentally, and if the main rod is of normal design, a reasonably close approximation can be obtained by assuming a value of 0.6 for $k^2 \div l^2$. The equivalent weight of the back end of the main rod is then six-tenths of the total weight.

$$W_{m_2} = 0.6 \times W_m.$$

Section II—To Resolve the Equivalent Weight of the Rotating Parts on One Side of a Pair of Wheels into Two Components, One in the Wheel carrying the Rotating Parts and the Other in the Opposite Wheel of the Pair

This section is illustrated by Fig. 1 (a) and (b). Items which are taken from Sec. 1 are given the same number here.

11. W_t = Total equivalent weight of rotating parts (Sec. 1)....2,490 lb.
13. F = Distance in inches from center of gravity of rotating parts to center plane of opposite counterbalance. (Sec. 1).....71.3 in.
1. E = Distance between center planes of counterbalances. (Sec. 1) ....62.0 in.
14. W_1 = Component of left hand rotating parts acting in center plane of left counterbalance.
$W_1 = W_t \times F \div E$....................2,870 lb.
15. W_t = Component of left hand rotating parts acting in center plane of right counterbalance.
$W_r = W_l - W_t$....................380 lb.

Section III—To Determine the Inertia Effect of the Eccentric Cranks

Fig. 7* shows the relative positions of the eccentric cranks. The center of gravity of each crank does not lie on the main crank radius. The crank cannot, therefore, be accurately represented by a single equivalent weight acting along the main crank radius. Each crank must be represented by two equivalent weights acting, one along the crank radius, the other along a radius 90 deg. ahead of this. This is illustrated by the isometric diagram in Fig. 8. In this, each eccentric crank is represented by two equivalent weights in the plane of rotation of the center of gravity of the eccentric crank. These four equivalent weights must be replaced by four others, two acting in each counterbalance plane. These are computed as follows:

16. W_e = Actual weight in pounds of one eccentric crank, together with weight of part of crank pin encircled by eccentric crank ....172 lb.
17. b = Length in inches of intercept of center of gravity of eccentric crank on crank radius (See Fig. 7)....................10.4 in.
18. a = Length in inches of intercept of center of gravity of eccentric crank on radius 90 deg. ahead of crank....................3.15 in.
19. D = Distance in inches between centers of gravity of eccentric cranks (Fig. 8)....................91 in.
1. E = Distance in inches between the center planes of counterbalances ....62 in.
R = Crank radius in inches....................15 in.

From these data are computed the component equivalent weights which, acting in the planes left and right hand counterbalances, represent completely the inertia effects of the eccentric cranks.

In Left-Hand Counterbalance Plane

20. L_{eb} = Component equivalent weight acting along crank radius
$$= \frac{W_e}{2RE}\,[b(D + E) + a(D - E)] \text{.........156 lb.}$$
21. L_{ea} = Component equivalent weight acting along radius 90 deg. ahead of crank
$$= \frac{W_e}{2RE}\,[a(D + E) - b(D - E)] \text{.........17 lb.}$$

In Right-Hand Counterbalance Plane

22. R_{eb} = Component equivalent weight acting along crank radius
$$= \frac{W_e}{2RE}\,[b(D + E) - a(D - E)] \text{.........138 lb.}$$
23. R_{ea} = Component equivalent weight acting along radius 90 deg. ahead of crank
$$= \frac{W_e}{2RE}\,[a(D + E) + b(D - E)] \text{.........73 lb.}$$

The equivalent weights are not the same in the two counterbalance planes, although the resultant is the same

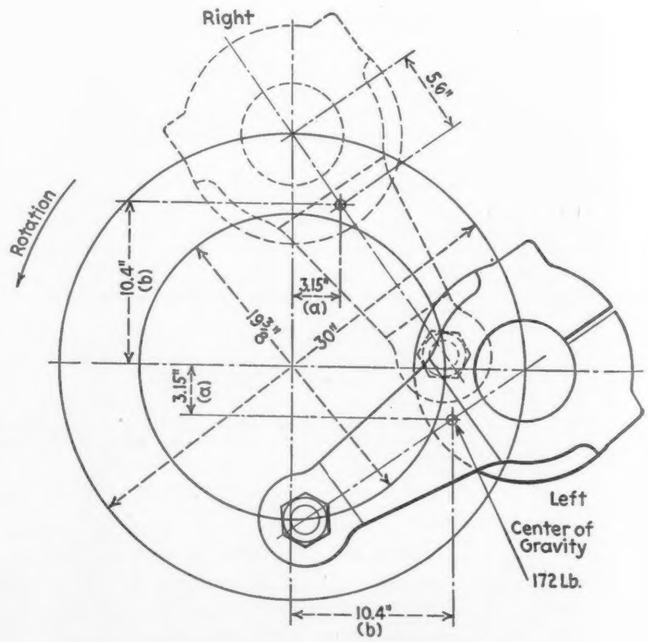


Fig. 7—Position of the eccentric cranks

in both planes. The reason for the lack of symmetry can be seen in Fig. 8. In the horizontal plane, through the main axle the 36 lb. component of the left eccentric and the 119 lb. component of the right eccentric both act in the forward direction. In the vertical plane, on the other

* The cranks are shown trailing. In Fig. 8 and the text, however, they are assumed to be leading the crank pins.

hand, the 119 lb. component of the left eccentric acts upwards, while the 36 lb. component of the right eccentric acts downwards.

Section IV — To Combine Inertia Effect of Eccentric Cranks and Other Rotating Parts

In Sections II and III the inertia effect of the other rotating parts and of the eccentric cranks have been resolved into equivalent weights acting in the center planes of the two counterbalances. The net effect of all the rotating parts is found by adding the values found in

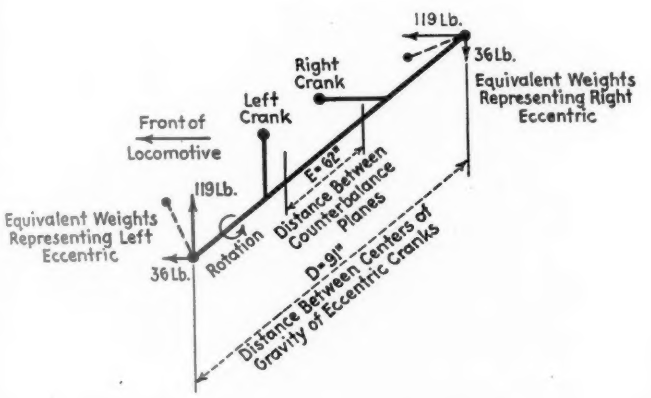


Fig. 8—Isometric diagram illustrating the replacement of each eccentric crank by two equivalent weights acting in the plane of rotation of the crank

the two preceding sections. The operation is illustrated by Fig. 9. The quarters of each wheel are numbered for convenience of reference.

In Left-Hand Counterbalance Plane
Diameter through Left Crank Pin:

14. W_l = Equivalent weight representing other rotating parts at quarter (1) .... 2,870 lb.
20. Leb = Equivalent weight representing eccentric cranks at quarter (1) .... 156 lb.

24. W'_1 = Net equivalent weight at quarter (1) .... 3,026 lb.

Diameter perpendicular to Left Crank:

15. W_r = Equivalent weight representing other rotating parts at quarter (4) .... 380 lb.
21. Lea = Equivalent weight representing eccentric cranks at quarter (2) .... 17 lb.

25. W'_4 = Net equivalent weight at quarter (4) .... 363 lb.

In Right-Hand Counterbalance Plane
Diameter through Right Crank Pin:

14. W_l = Equivalent weight representing other rotating parts at quarter (2) .... 2,870 lb.
22. Reb = Equivalent weight representing eccentric cranks at quarter (2) .... 138 lb.

26. W''_2 = Net equivalent weight at quarter (2) .... 3,008 lb.

Diameter perpendicular to Right Crank:

15. W_r = Equivalent weight representing other rotating parts at quarter (3) .... 380 lb.
23. Rea = Equivalent weight representing eccentric cranks at quarter (3) .... 73 lb.

27. W''_3 = Net equivalent weight at quarter (3) .... 453 lb.

Fig. 9 illustrates these operations. The figures are the same as in Fig. 1 (c). Items 24, 25, 26, and 27 give the four equivalent weights which, acting two in each counterbalance plane, completely represent the inertia effect of all rotating parts, including the eccentric cranks. Having these, it is a simple matter to complete the analysis of the wheels by adding the effect of the counterbalance as in Fig. 1 (e). The net equivalent weights representing counterbalances and all rotating parts are shown in Fig. 1 (f). Details of the operation are given in Section VII.

Section V — To Find the Position and Value of the Maximum Dynamic Axle Load when the Resultant Equivalent Weights Producing Dynamic Augment in the Wheels Are not the Same

This section is illustrated by Fig. 10

28. W_l = Resultant equivalent weight in pounds producing dynamic augment in left hand wheel .... 138 lb.
29. W_r = Resultant equivalent weight in pounds producing dynamic augment in right hand wheel .... 132.5 lb.
30. Z = Angle in degrees between planes in which the above equivalent weights act .... 119 deg. 15 min.

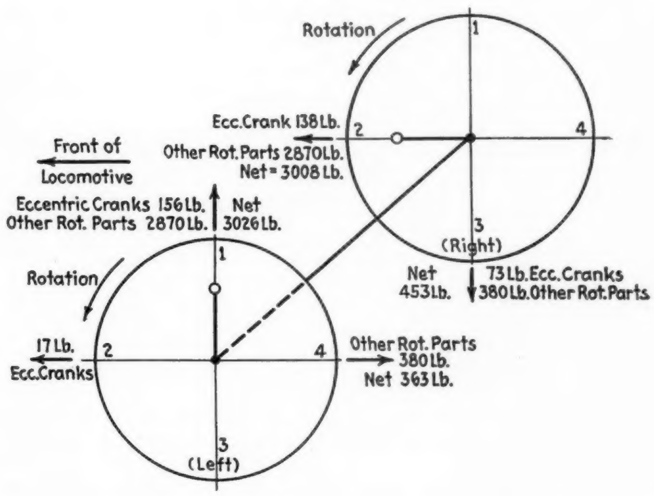


Fig. 9—Equivalent weights acting in center planes of counterbalances representing eccentric cranks and other rotating parts

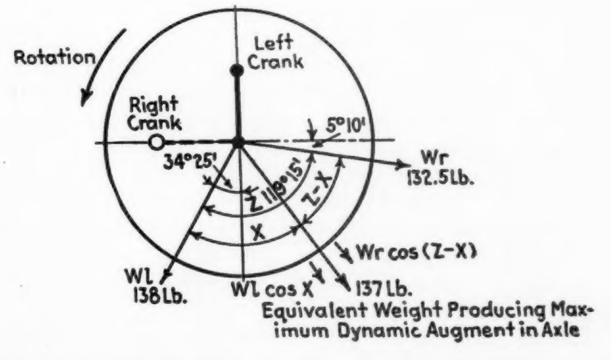


Fig. 10—Computation of maximum dynamic augment in axle when equivalent weights producing maximum dynamic augments in wheels have values Wl and Wr and stand at an angle Z from each other

Assume that in the position of maximum axle dynamic augment.

31. X = Angle in degrees between direction of left hand resultant and the vertical.

then
Z — X = Angle in degrees between the direction of right hand resultant and the vertical.

It follows that
$W_l \cos X$ = vertical component contributed by left hand resultant.
$W_r \cos (Z - X)$ = vertical component contributed by right hand resultant.
Then $W_l \cos X + W_r \cos (Z - X)$ is the total equivalent weight producing the maximum dynamic augment in the axle.

This has its maximum value when

$$\tan X = \frac{\sin Z}{W_l/W_r + \cos Z}$$

With the values given above for W_l, W_r, and Z, the value of X is found to be 57 deg. 40 min. Then the

total equivalent weight producing the maximum dynamic augment in the axle:

$$\begin{aligned} Wl \cos X + Wr \cos (Z - X) &= 138 \times 0.535 + 132.5 \times 0.476 \\ &= 74 + 63 \\ &= 137 \text{ lb.} \end{aligned}$$

Section VI—Determination of Equivalent Weight and Position of Counterbalance To Exactly Balance the Rotating Parts and Provide a Given Over-balance for the Reciprocating Parts

This section is illustrated by Fig. 3. A blank diagram similar to Fig. 3 should be used, and the values should be filled in as described. In the following description the diagram is assumed to represent the left hand wheel of the pair and the quarters are numbered 1, 2, 3, and 4. Quarter No. 1 being that of the left hand crank pin.

24. W'_1 = Component of rotating parts acting in plane of left counterbalance at quarter (1); see Sec. IV .... 3,026 lb.
25. W'_4 = Component of rotating parts acting in plane of left hand counterbalance at quarter (4); see Sec. IV ..... 363 lb.
32. W_0 = Equivalent weight of over-balance to be added to oppose the reciprocating parts .... 66 lb.
[The value to be given this item may be chosen arbitrarily. The better plan is to determine it to hold the dynamic augment to a definite limiting value.]

33. Wc_3 = Component of counterbalance to act in quarter (3), opposite the crank pin = Item 24 + Item 32 .... 3,092 lb.
34. Wc_2 = Component of counterbalance to act in quarter (2). $Wc_2 = W'_4$ .... 363 lb.
35. Wc = Resultant equivalent weight of counterbalance to produce the components shown in quarters 3 and 4 in Fig 3 (b)

$$Wc = \sqrt{Wc_3^2 + Wc_2^2} \text{ .... 3,113 lb.}$$

36. a = Angle which radius through center of gravity of counterbalance makes with the diameter through quarters 1 and 3.

$$\begin{aligned} \tan a &= Wc_2/Wc_3 = 363/3092 \\ &= 0.1275 \\ a &= 6 \text{ deg. } 42 \text{ min.} \end{aligned}$$

The equivalent weight and position of the counterbalance thus determined are shown in Fig. 3 (c)

In designing the actual counterbalance to have this equivalent weight proper allowance must be made for the equivalent weight of the spokes and rim adjacent to the crank-pin hub which occupy the space corresponding to the space covered by the counterbalance in the opposite quarter of the wheel. The counterbalance determined by Items 35 and 36 will exactly cross-balance the reciprocating parts, and the only unbalanced mass producing dynamic augment will be the over-balance of equivalent weight W_0 acting in quarter (3) directly opposite the crank pin.

It may be noted that it is important to cross-balance when the value of W_r, the component due to the rotating parts of the opposite wheel, is large compared with W_0, the over-balance. If W_r does not exceed $0.25 W_0$, it is unnecessary to cross-balance. If $W_r = 0.25 W_0$, a counterbalance of equivalent weight $W_{e4} = W_1 - W_0$ can be placed directly opposite the pin at quarter (3) and the dynamic augment will not exceed that of the cross-balanced wheel by more than 3 per cent. This is practically negligible.

Section VII—Analysis of a given Counterbalance To Determine the Exact Over-balance and Dynamic Augment

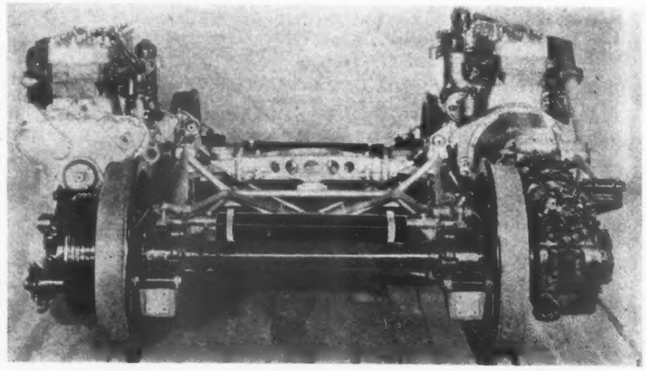
This section is illustrated by Fig. 1(d) and 1(e).

37. We = Equivalent weight of counterbalance in pounds .... 3,170 lb
38. b = Angle made by radius through center of gravity of counterbalance with diameter through quarters 3 and 1. Fig. 1 (d) .... 8 deg.
39. We_3 = Component of counterbalance acting at quarter (3) $We_3 = \cos b \times We$ .... 3,140 lb.
40. We_2 = Component of counterbalance acting at quarter (2) $We_2 = \sin b \times We$ .... 441 lb.

Burgess Mufflers Used on Railplane

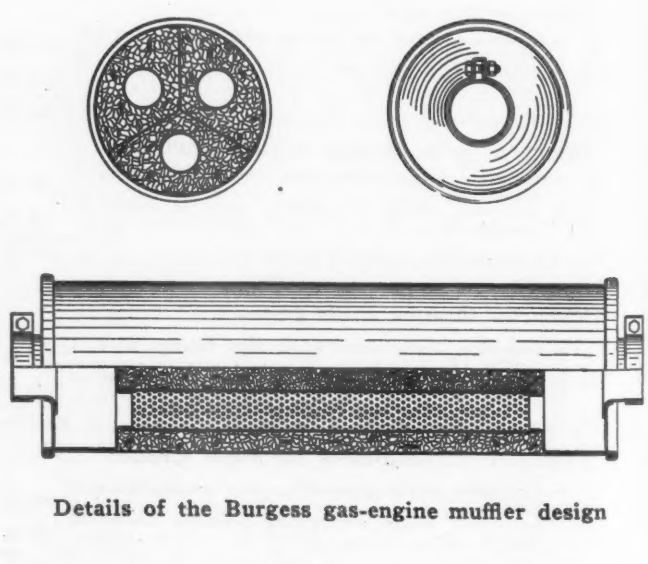
THE Railplane, built for and under the direction of the Pullman Car & Manufacturing Company by the Stout Engineering Laboratories, Dearborn, Mich., incorporated a modern adaptation of airplane principles to rail car design. The car is driven by two 160-hp. Waukesha motors.

To muffle the exhaust noises of these large motors without decreasing the effective power output, mufflers of the Burgess straight-through, full-power type were applied, as shown in one of the illustrations.



Burgess mufflers as applied to the Waukesha engine exhausts on the Railplane power truck

With no baffle plates, back-pressure is said to be reduced to the minimum in these mufflers. They are made in accordance with the same principles employed by the Acoustic Division of the Burgess Battery Company, Madison, Wis., in mufflers which are standard equipment on many of the leading American and European automobiles.



Details of the Burgess gas-engine muffler design

Effective sound absorption is accomplished by a straight, perforated-tube lining backed up by a sound-absorbing packing. Keeping the back-pressure at a minimum tends to permit the motor to develop full-power, accelerate rapidly and operate at high speeds with minimum gasoline consumption.

The Effect of Sulphur On Aluminum Cars

Seventy-ton cars in the service of the Alcoa Ore Company for a period of two years show no indications of corrosion

THE transportation of sulphur, or of materials with a sulphur content, has always been a cause of grave concern to railroads, because of the fact that sulphur so readily attacks side and slope sheets of hopper cars.

Ten 70-ton hopper cars, with bodies of aluminum, were placed in service by the Alcoa Ore Company two years ago.[1] It was the first time that aluminum had been suggested for hopper car construction. Theoretically its use was sound, but actual service tests had not been made, and both railroad officers and car builders were awaiting the results of these tests with interest, to see whether aluminum would be strong enough to withstand the heavy loads it was expected to support.

The ten cars were used for transporting bauxite from the Alcoa Ore Company's mines in Arkansas to East St.

Five of the 10 aluminum hopper cars which have been in service for two years

Louis. About the same time the Missouri Pacific decided to test an aluminum hopper car in the sulphur service, in order to see how the new metal would withstand the attacks of sulphur.

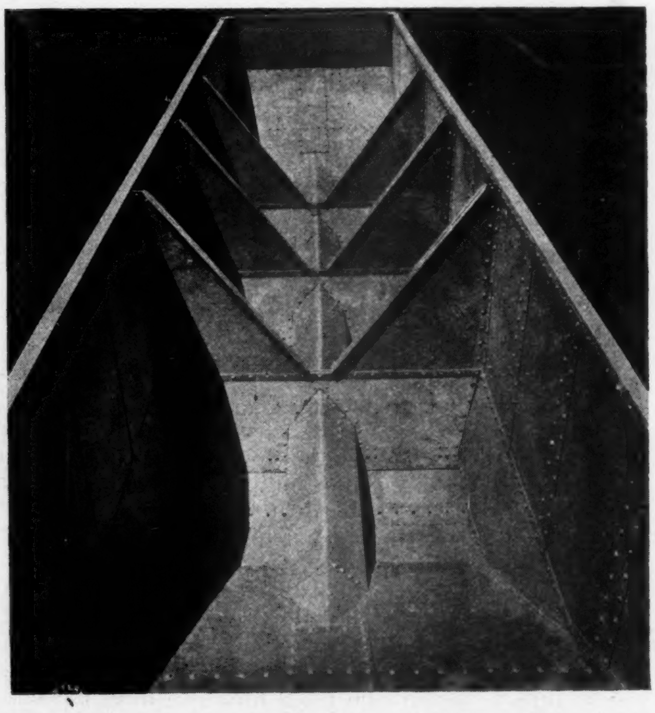
A car identical in type with the other ten was leased to the Gulf Coast Lines, and was used to take sulphur from deposits located at Bryan's Mound and Hoskin's Mound to Freeport, Texas.

A report on the car was made every month, which included the number of loads carried during that period, the nature of the repairs required, and details concerning the deterioration, if any, noticeable on the side and slope sheets of the car.

The only repair made consisted in replacing a hopper chain, not of aluminum, which broke early in service. Since then the car has made 116 trips fully loaded with sulphur and has travelled, thus loaded, a distance of 2,540 miles.

It was noted that the slope sheets, instead of corroding and forming a scale which would retard dumping operations, remained bright and shiny, and the contents could be dumped faster than if the car had been made of ordinary materials.

This discovery was quite remarkable, particularly since corrosion conditions are usually so severe. Cases are on record where hopper cars, loaded with coal (which con-



The interiors of the cars indicate the ability of aluminum to withstand corrosion

tains sulphur up to 4 per cent), have stood in railroad yards near Lake Superior from autumn to spring. The corrosion resulting from sulphur attacks was so pronounced that the bottoms of the cars dropped out, along with the coal, after the latter had been stored in the hoppers for only a few months.

The theory that sulphur had no effect on aluminum was accordingly tested by placing the aluminum hopper car in service. It was also reasonable to assume that if

[1] These cars were described in detail in the *Railway Mechanical Engineer* for April, 1932, page 131.

aluminum could withstand the direct attacks of sulphur, then it should certainly be an ideal material for cars carrying such sulphur-bearing material as coal.

In order to test this assumption, scientists of Aluminum Research Laboratories, New Kensington, Pa., placed three aluminum hoppers outside the laboratories, filled them with coal, and left them there for two years.

The coal used in the experiment was bought especially for its high sulphur content. The hoppers were built of the same alloy used in the construction of the car for the sulphur trade. After two years, no noticeable depreciation in the aluminum could be found. The thickness of the aluminum sheet was the same as that of the steel ordinarily used.

Steel sheets for sulphur-carrying hopper cars, incidentally, are made to special thickness in order to combat corrosion as much as possible. The aluminum sheets used in hopper cars now under construction are $\frac{1}{16}$ in. thinner because the additional thickness was not necessary.

While the tests on this new type of carrier were made by the Missouri Pacific, several other railroads placed test cars in operation. Results so far obtained support the service experience of the aluminum hopper cars on the Gulf Coast Lines.

The car has a length over striking castings of 41 ft. 11 in.; an inside length of 39 ft. $11\frac{7}{8}$ in.; an inside width of 9 ft. 6 in.; and a height of 10 ft. 6 in. from rail to top of body. As constructed by the Canton Car Company, Canton, Ohio, the car weighs 38,900 lb. Similar cars built for the Alcoa Ore Company to the same general dimensions, but utilizing heavier materials, weigh 60,000 lb., or 21,200 lb. more than the aluminized unit.

Budgeting Locomotive Department Expenditures*

By J. A. Anderson†

THE budgeting of locomotive department expenditures is a correlation of the maintenance and servicing of equipment with the financial allowance available for those purposes, to best meet the service and federal requirements.

Probably the best way to exemplify budgetary control is to outline its operation in the locomotive department of the Milwaukee. The present system of budgeting is the result of the failure or inadequacy of the former practice of allocating a given number of employes for each point, specifying classification and rates of pay. This system was not alone impractical, but expensive as well—particularly when a general officer, located at a great distance from the scene of activity, was endeavoring to regulate the maintenance and servicing forces without being fully acquainted with the details of changing service and maintenance demands.

The budgeting system in use at present operates along the following lines: Each master mechanic and shop superintendent receives a monthly allotment of money for each point where employes under his jurisdiction are located, the amount designated being based on payroll estimates submitted by these officers. The division officers have the authority to balance their forces to best suit the operation, that is, to regulate the number of journeymen and helpers of each craft to correspond with the amount of work contemplated for these craftsmen, and to adjust the common labor forces to meet the service requirements. The officer in charge is further permitted to control his allotment from a divisional standpoint in order that he may divert sufficient money from one point to another on the same division to take care of fluctuating demands caused by local conditions.

The Basis of the Budget

The budget control system similarly provides an allotment system for locomotive repairs separate from the amount alotted for the remainder of the labor expense. To this end, the proper levels of locomotive maintenance and servicing costs were determined after a thorough survey of accumulated records of maintenance costs and mileage made by individual locomotives. The maintenance statistics used included the costs of labor and material separately and collectively.

As locomotive mileage and the cost of maintenance and servicing were the only data that could be promptly and conveniently assembled, the cost per locomotive mile was the unit selected for comparative purposes on locomotive repairs. For enginehouse expense, the unit cost per locomotive handled at each terminal, and the cost per mile by divisions was used.

The ratios of material costs to labor costs were developed from analysis of material and labor costs, and by applying this ratio it is possible to foretell with a surprising degree of accuracy the aggregate costs of locomotive handling and maintenance for the ensuing month.

For the purpose of controlling and checking current expenses, statements of locomotive miles run and payroll totals, subdivided between locomotive maintenance and other expenditures, are prepared as of the 7th, 15th, 23rd, and last day of each month, the data from which these statements are compiled being available a few days after the close of each period.

After the close of each month, data are collected and statements are prepared showing by divisions and classes of locomotives the maintenance cost per locomotive mile, the cost of repairs to individual locomotives by the various shops, the cost per locomotive handled by locatoins, and the cost per mile for enginehouse expense by divisions. Each master mechanic and shop superintendent is furnished with copies of these reports, together with a copy of the statement showing charges for labor, material and other expense to individual locomotives.

In this connection, an organized and well balanced program for the performance of locomotive classified repairs, designed to restore run-out locomotive miles, has been followed. This arrangement includes a require-

*Abstract of a paper presented before the Western Railway Club on Monday evening, January 15, at the Hotel Sherman, Chicago.
†Master mechanic, C. M. St. P. & P., Milwaukee, Wis.

ment that the master mechanic furnish ninety days in advance of the proposed shopping date, a condition report for each locomotive that is coming due for classified repairs, this report indicating in detail the work which will be necessary to restore the locomotive to a condition which will guarantee another full cycle of mileage. While reduced earnings during the last few years has had a somewhat disorganizing effect on the operation of our shops, careful budgeting and strict control of expenditures have enabled us to maintain in desirable condition at greatly reduced costs, sufficient locomotive power to handle, without detention, the tonnage moved over our railroad during the past three years as well as the increase in business which it was our good fortune to handle during the past six months, and with a margin of good power still in storage to cope with demands should business increase beyond the peak reached during the summer months.

The labor allotments and cost statements developed in connection therewith have enabled the division officers, as well as the supervisors in each group, to realize that they must conserve to the fullest extent the expenditures for material and the charges to shop expense, as well as the monetary disbursement for direct labor, if their cost per mile is not to be excessive when compared with similar operations on other divisions. This has also promoted a close study by the officials and supervisors of each group of all items of expense entering into the respective operations.

Penalty Overtime Greatly Reduced

Penalty overtime, prior to budget control, was not curtailed to the extent that economical operation demanded. This was due in part to insufficient flexibility in local control of working forces and to some extent, perhaps, to lack of vigilance on the part of supervisors whose anxiety to expedite repairs to certain units of equipment by working employes overtime was substituted for better judgment and the more economical status of having the work performed during the regular bulletined hours.

It was convincing proof to all that in order to obtain the greatest possible production from an allotment strict curtailment of overtime hours at penalty rates was essential. The allotment basis, together with authority to regulate forces, while not effecting a complete cure to the extent of eliminating all overtime, was a remedy which prevented all except that overtime which was inevitable on Sundays and holidays and that occasioned by emergencies, in which the necessity for the immediate restoration to service of damaged or defective equipment would not permit deferring repairs until they could be made during the hours designated by bulletin, as the regular working week day, when straight time applies.

Although the total annual locomotive department payroll has been reduced almost 60 per cent during the last eight years, the percentage of penalty overtime to total payroll has been lowered each year.

The possibilities and opportunities for a more economical operation were further enhanced by the fact that under budget control the operation at each point constitutes a business all its own, and the supervisors in charge are granted authority to display their talent as business men as well as their ability to maintain and service locomotives. Their problems was transformed from one where the primary object was to perform a certain amount of work with a fixed mechanical and laboring force and with scant attention paid to costs, resulting in lack of proper return for the money expended, to one in which it is imperative that a certain amount of work must be accomplished for a fair allowance of money, based on equitable comparisons, to cover the task to be completed.

Investigation as to the extent to which budgetary control is used on other railroads discloses various systems, some roads adhering to the man allotment, while others have amplified the system here described and issue a maintenance of equipment allotment to the divisional mechanical heads who further subdivide the allowance into labor, material and fixed charges. I have worked under all three systems. The one in use on the Milwaukee Road is simple, meets the service requirements, and is a system whereby the expenses can be controlled, giving the division mechanical officer sufficient authority to properly balance his working force.

The Saving of Life and Limb*

Remarkable advancement has been made, but much still remains to be done

"YOUR railroad has made an excellent record in recent years in reducing the accidents to employees. Won't you tell me what, in your opinion, the officers and foremen of the mechanical department can do to reduce still further the number of such accidents?"

This question was addressed to the Superintendent of Safety—a man who has been engaged in this work for many years. We had followed his progress closely, not only because of the noteworthy results obtained, but also because he is distinguished for his clear thinking and his fearless efforts to improve conditions.

Discipline and Breaches of Rules

"In the first place," he replied, "and in order that you may have a proper background, let me say that our practices in general are not materially different from those of other railroads which are included in the upper 25 per cent, from the standpoint of safety performance. We attempt to thoroughly educate our employees in, and to inspire them to follow, the rules and practices which we have established in the interests of safety. We carefully check up each accident to place responsibility and take necessary corrective action. More than this, we insist that the supervisors report instances of non-observance of our rules, even if no accident occurs, and that such delinquencies be treated exactly as if an

* Eighth of a series of interviews with men outside the mechanical department, commenting in a constructive way upon the possibilities of that department.

accident had actually resulted from each breach of rules."

"You discipline them even if no accident occurs? Isn't that going to unusual lengths?" I asked.

"Some people seem to think so," replied the Safety Superintendent. "We know from experience, however, that such a handling produces real and substantial results. You cannot afford to compromise with safety principles. It is a serious offense to overlook an unsafe practice, whether the particular instance results in an accident or not. It is a potential source of danger and the next breach may result in a serious accident, or even a fatality. Unfortunately, this is constantly being brought home to us." (He showed me recent records of fatalities caused by violations of specific rules.)

Where Foremen Fall Down

"Getting down to a more direct answer to your question," continued the Superintendent of Safety, "I would say that our chief endeavor is to get the foremen to comprehend clearly and to assimilate the safety rules, to imbue them with a realization of their responsibility for the safety of those under their direction, and that no operation is an efficient operation unless it is also a safe operation. In this we have had a considerable measure of success as our records in recent years show. There is, however, much still to be accomplished."

"In my opinion," continued the Superintendent of Safety, "every man employed in a supervisory capacity should have a 'safety sense,' as it were, developed by a thorough study and understanding of the safety rules and a carefully cultivated keenness to discover and correct unsafe methods and practices. We spend a lot of time and money to correct defects in a locomotive, a car, or a machine tool, in order to guard against possible failures in service. Why should we not be as careful and critical in examining and training each employee to insure against possible accidents?"

"What evidence have you that some foremen are indifferent?" I queried.

"For one thing," replied the Superintendent of Safety, "certain groups are always consistently below their fellows in safety performance. For another, our checks show clearly that some foremen are not observant of breaches of rules. They seem to have no sense of unsafe practices, even when they are quite pronounced. One cannot escape the conclusion that these foremen are either too lazy or too indifferent to voluntarily exert a reasonable amount of energy to study and concentrate on this problem."

"Is this not sufficient cause for their demotion or elimination from service?" I ventured.

"I believe it ultimately will be," promptly answered the Superintendent of Safety. "It surely will be, in my opinion, as we succeed still further in raising our standards and approach more nearly to our ideals—and we surely have made rapid progress in the railroad field in recent years in demonstrating that safety is an integral part of efficient operation, in addition to increasing the respect and appreciation for the value of life and limb."

Getting a Line on the Individual

"After all," I remarked, "is not the problem in its last analysis that of reaching each individual in the organization and of securing his wholehearted co-operation?"

"Absolutely," came back the answer. "And this means that a careful study must be made of the performance of each individual in the organization. Incidentally this will prove invaluable in other directions. For instance, focusing the attention of the foremen upon such a study and analysis of the individual will be extremely helpful in finding ways and means of making that individual a more efficient employee in other respects and in encouraging a greater loyalty on his part to the railroad."

"Will it mean the elimination of employees who insist upon following questionable practices?" I asked.

"Quite probably," replied the Superintendent of Safety. "But, frankly, I do not believe there will be many such separations from the service. As a matter of fact, it is so much to the employees' interest to follow safe practices that I believe we can expect a maximum of co-operation if we can convince them of this fact, and surely the officers and foremen should be able to do that if they themselves are fully sold on the proposition. As a matter of actual experience the great majority of employees go along with safety cheerfully after a certain period of training."

"The railroads generally have made splendid progress in safety performance in recent years," I said. "Can we expect to greatly improve upon the present performance?"

"Certainly," replied the Superintendent of Safety. "A careful analysis indicates that many of our accidents are entirely inexcusable and are due to 'human failures.' Education; closer and more intelligent supervision; fair, impartial, but invariable discipline for proved violations—and a wholesome fear of it—will still further reduce the number of accidents in railway service."

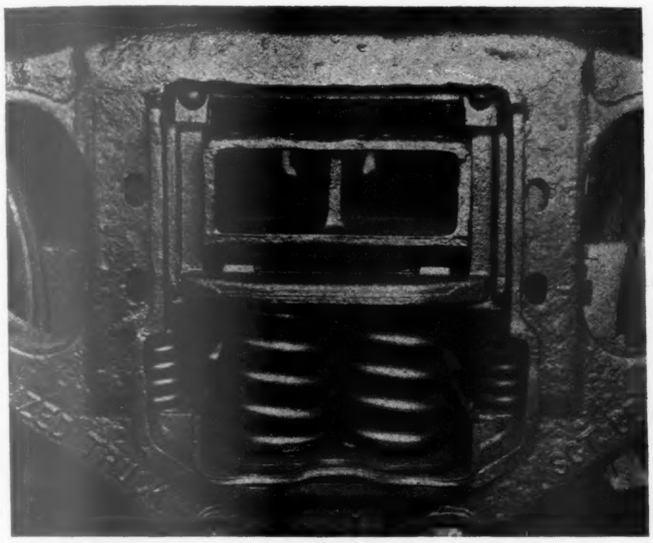
Barber Stabilized Truck

After two and a half years of extensive research, laboratory experiments and road tests, the Standard Car Truck Company, Chicago, announces the development of a new freight-car truck design which, in addition to other important features, is said to prevent excessive vertical oscillation of car bodies at critical speeds, thus minimizing damage claims, reducing car maintenance costs and providing increased safety at modern high operating speeds. The truck, known as the Barber stabilized truck, is designed for use (either with or without the Barber lateral-motion device) on cars of all capacities. It comprises essentially conventional construction, except for the provision of friction elements under spring tension in the side-frame columns to dampen the vertical movement of the spring-supported bolster. This dampening effect, which is proportional to the car load, tends to assure easy riding at all speeds and, in effect, provides increased spring capacity when most needed.

The new Barber stabilized truck has been tested under the drop hammer at the American Railway Association draft-gear laboratory, Purdue university, and in the A. R. A. road service tests recently conducted at Rochester, N. Y. Additional road tests have been made with the stabilized truck under Santa Fe and Swift Refrigerator Lines' cars, two of these test installations having been in service for a period of over 13 months. Advantages said to have been demonstrated in tests of the new truck design include: (1) Effective dampening of vertical oscillation due to harmonic spring action; (2) increased spring carrying capacity from 12 to 15 per cent without the use of additional springs; (3) elimination of all wear between the bolsters and columns because these members do not contact; (4) provision for vertical friction members which are self-cleaning and en-

closed in columns where they are, to some extent, protected; (5) reduction of car roll to a minimum because of the dampening of spring action; (6) tendency to eliminate broken truck springs, due to the reduction of excessive vertical oscillation; (7) practical elimination of lost motion or looseness in the truck, since the small amount of wear anticipated on the friction blocks is automatically taken up as it develops.

The stabilized truck utilizes side frames furnished by any of the side frame manufacturers, who may be licensed to arrange for the slight change necessary in the column design. Standard A. R. A. bolsters are used, except that



Close-up view showing details of Barber stabilized truck, including the application of the Barber lateral-motion device

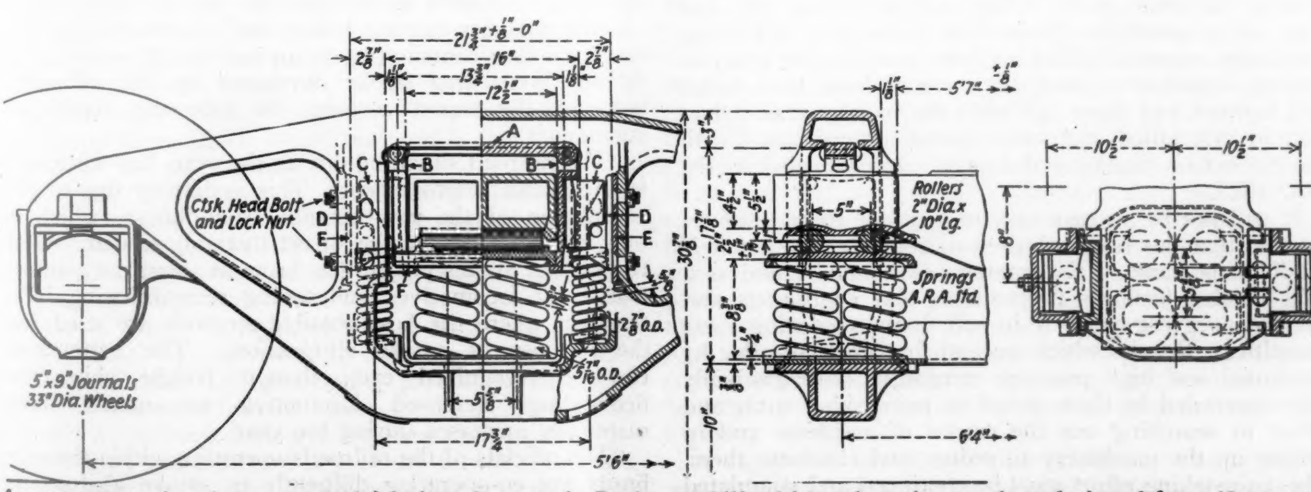
with the Barber lateral motion application a slight change in the bolster is required. The coil springs also are of standard A. R. A. design, the four large outer coils being located as usual under the bolster ends and two small inner coils being transferred from their usual location to the side-frame columns where they provide necessary tension on the tapered friction elements.

Referring to the drawing, the construction of the Barber stabilized truck for a 40-ton car, including the application of the lateral-motion device, is illustrated. A yoke, consisting of a cast-steel top compression bar *A* and two cast-steel side members *BB*, is located around the bolster. The lower edges of the side members are flanged to engage the underside of the lateral-motion roller plate *F*. Wedge members *CC* are also of cast steel and make contact on a plane of 60 deg. with the chrome-nickel friction blocks *DD* producing a frictional resistance against the hardened wear plates *EE* which are secured to the columns of the side frames by suitable countersunk bolts and lock nuts. It is the friction produced at this point which breaks up the destructive harmonic action of the truck springs, permitting just enough movement to give an exceptionally easy riding car, whether empty or under full load. Another important factor in the design is that the outer faces of the vertical members of the yoke are provided with a convex surface, or rocker face, to compensate for irregularities in the manufacture of the side frame. This assures full and uniform bearing of the friction block against the wear plate.

The use of the Barber lateral-motion device is recommended, but, should this feature not be desired, the Standard Car Truck Company has provided for a design which does not incorporate this feature. In that case, the yoke is eliminated and the standard A. R. A. truck bolster inserted. The cast-steel wedge blocks are provided with lugs on the lower edges to engage the truck bolster, instead of the roller plate as in the initial design.

The standard A. R. A. Class C springs, with 40-ton capacity per car, have a solid capacity rating of 57,000 lb., of which the two inner coils produce 7,000 lb., or 12.28 per cent of the group. The Barber wedges, which are of cast steel, are designed with a 60-deg. angle; therefore, the horizontal component pressing against each side of the yoke or bolster is about 6,060 lb. at solid capacity. The friction blocks have a chrome-nickel content with a bearing surface chilled and ground and a contact area of 76 sq. in. per side frame. This produces 160 lb. of pressure per sq. in. at full or solid capacity; but, under normal full loads, this pressure will not exceed 50 per cent, or 80 lb. per sq. in. This low unit pressure tends to promote long service life.

Under drop test in the Purdue laboratory using the 27,000-lb. tup, the free oscillations of this Class C spring group, 15 in number, were reduced to three with the Barber stabilized device. The Purdue tests also indicated that by reason of the frictional "build up," the foot-pounds of energy absorbed in producing a full spring closure of $1\frac{11}{16}$ in. were increased from 4,050 to 4,610, an increase of 13.8 per cent in actual capacity of the spring group. This was in addition to absorbing the harmonic timing or bouncing and tends to prevent the springs going solid. The limited action of the springs also is expected to prevent the repeated development of excessive stress which is a prolific cause of fatigue failures and spring breakage.



Arrangement of spring-supported friction elements in Barber stabilized lateral-motion truck as designed for a 40-ton car

EDITORIALS

Safeguarding Employees From Accidents

In an interview on The Saving of Life and Limb, reported on another page, a superintendent of safety makes some excellent suggestions as to how the mechanical department can improve its record in that respect. Seventy-five per cent of the total so-called industrial accidents on the railroads are said to be in the maintenance-of-way and equipment departments. In 1932 the total casualties in the maintenance-of-way department were 4,965 and in the maintenance-of-equipment and stores departments 4,733. The average casualty rate for the 29 occupations listed in the maintenance-of-equipment and stores department was 6.59, and 13 of these occupations had rates above this average. Eliminating four of these occupations which have comparatively few employees, we find the following results:

Occupation	Number of Casualties	Casualty Rate
Carmen, class B	56	11.36
Carmen, class A	288	10.44
Regular apprentices	110	9.38
Boilermakers	222	8.72
Laborers in shops, enginehouses and power plants	642	8.55
Helper apprentices	41	8.52
Machinists	780	8.49
Blacksmiths	73	7.06
Common laborers in shops, enginehouses and power plants	523	6.49

These facts give some indication, at least, of places where efforts can be focused to effect the largest reductions, although the casualties, even in those occupations with the best records, are still too large, and no reasonable effort should be neglected to reduce them still further.

Incidentally, the railroads can take some pride in the results that have been obtained in the past ten years by concentrating attention upon accident prevention. Important factors in this campaign have been the annual awards of the Harriman Memorial medals and certificates under the direction of the American Museum of Safety, and the Railroad Employees' National Safety Contest, under the direction of the National Safety Council. In commenting on the Railroad Employees' National Safety Contest last year, the president of the National Safety Council said: "An analysis of the progress made during the nine years of the contest reveals the fact that on a cumulative basis there have been 3,003 less employees reported killed on duty, and 451,018 less employees reported injured, than would have been killed and injured had there not been the year-by-year reduction in rate killed and rate injured, as compared with the respective fatality and injury rates recorded in the year 1923."

It will not be an easy task to continue the rate of reduction that has been achieved in recent years, but it is vitally important, in the interests of humanity and as a cold-blooded business proposition, that continuous and decided progress be made in still further reducing these casualties. Results which were at first made possible by emotional and high pressure campaigns have gradually been succeeded by those based on painstaking study and effort in searching out the causes of accidents and in setting up the machinery to reduce and eliminate them. This painstaking effort must be continued and stimulated in order to create a universal habit or "safety sense" among the employees on American railroads. The mechanical department, because of the large number of casualties among its employees, must shoulder a considerable part of this responsibility.

Engine Terminal Smoke Abatement

Early in 1933, the new Union passenger terminal at Cincinnati, Ohio, was placed in service, being designed to serve all seven of the railroads entering the city, and comprising, among other carefully co-ordinated facilities, a modern power plant and engine terminal. A point particularly stressed in the design of the latter units was the provision of modern equipment to minimize smoke and enable the terminal to meet the rather rigid requirements of the local smoke ordinance. Steam for all heating purposes, as well as for generating compressed air for the terminal, is furnished by three efficient high-pressure boilers of 1,000-hp. capacity each, located in the main power plant. These boilers also supply steam which is used directly in locomotives for building up steam pressure after the boilers have been washed out and refilled, and without the necessity of starting fires while the locomotives are in the enginehouse, or, in fact, until just before they are assigned for service. All 20 of the stalls in the enginehouse and 10 of the outside radial tracks are equipped with high-pressure steaming and blow-off mains for blowing down, washing, refilling and steaming locomotive boilers by this method, and the remaining seven outside radial track stations are equipped for maintaining a working steam pressure on the locomotives without fires.

The effectiveness of this method of engine-terminal operation in reducing objectionable locomotive smoke was rather strikingly emphasized in the 1933 annual report of the Smoke Abatement League of Cincinnati, as prepared by Secretary Frank H. Lamping. This report comments on the increased difficulty of smoke-abatement efforts in 1933, owing to economic conditions which have tended to increase the use of cheap, high-volatile coal for heating homes and apartments in that territory, thus contributing to an undesirable smoke condition. Regarding smoke developed by the railroads, however, the report contains the following significant statement:

"The railroad situation, during the year, has witnessed a remarkable improvement. This is directly due to the completion of the new terminal roundhouse, which is now operating under the direct-steaming system. The completion of this project has brought about the concentration of locomotives undergoing reconditioning in a terminal where the best possible methods are used for the purpose of smoke elimination. The betterment can be recognized even though freight shipments demanding increased locomotive movements have materially increased during the year.

"The officials of the railroads operating within the city limits are co-operating diligently in smoke abatement. They are continually improving equipment and firing

methods in order to bring it about. During the year, the Cincinnati Superintendents' Committee, through their smoke department, took the following disciplinary action, not so much for punitive measures, but to keep the work constantly before the employees of the railroads."

Total railroad observations	19,182
Number of violations	261
Percentage of total	1.4
Reprimanded	113
Demerits	42
Suspended five days	29
Suspended ten days	43
Cautioned—Previous good record	18
Contributory causes	11
Dismissed	5
Out of service	10
First offense	1

Another large industrial center in which the railroads are co-operating with the local smoke-abatement offices is the Chicago district, where an extensive, systematic study is being made of all industrial and railway fuel-burning equipment and firing methods, using a special force of 150 trained engineers and observers. This study, conducted under the general direction of Frank A. Chambers, deputy inspector, Department of Smoke Inspection and Abatement, Chicago, is being financed by the federal government as part of its increased employment program and must be completed in three months.

While most of the information from this study will be devoted to industrial fuel-burning equipment, an important part of the study will cover railway fuel-burning practices at terminals and yards throughout the district, and it is already apparent that, with the co-operation of responsible railway officers, a substantial improvement in smoke conditions can be obtained in conjunction with an equally desirable increase in the efficiency of fuel use.

New Loading Rules Book Wins Approval

The approved loading rules of the American Railway Association, Mechanical Division, have been developed over a period of many years, and represent a tremendous volume of work in the aggregate in testing and specifying methods of loading various commodities with the required degree of safety and at a reasonable cost. As pointed out by C. J. Nelson, superintendent of the Chicago Car Interchange Bureau, at the February meeting of the Chicago Car Foremen's Association, the classes of shipments gradually increased in number resulting in a substantial increase in the size of the book of rules and, moreover, necessitating numerous cross-references to avoid repetitions which would have made the rule book still larger and more unwieldy.

To meet the demand for a rule book of more convenient size and ready reference, the arduous task of revision was undertaken in the latter part of 1931 and completed in the new book prepared by the Committee on Loading Rules and issued for general use, effective January 1, 1934. In spite of adding some new details, the committee was successful in reducing the size of the book considerably and eliminating practically all cross-reference, except references back to the general rules. Changes in the book arrangement have been made without changing the intent of any of the former rules and the few changes in rule details have been formally approved by letter ballot.

Detailed changes in the arrangement of the book of loading rules were discussed at length at the car foremen's meeting mentioned, and, judging by the favorable comment in that discussion, the new book will meet the approval and needs of car inspectors and supervisors generally.

Air-Conditioning Here—What About Insulation?

Rather complete information furnished in tabular form in the February *Railway Mechanical Engineer* indicated that a total of 648 air-conditioned passenger cars were in service in the United States up to December 31, 1933. Since the first of this year, the desirability of this modern improvement in passenger equipment has received such general acceptance and support by carriers throughout the country that many additional orders have been placed or are contemplated, arrangements having been made to finance some of these installations by government loans. All types of equipment are contemplated, including electro-mechanical, direct-mechanical, ice and steam-ejector systems, and installations will be made not only in lounge cars and diners, but in sleepers and day coaches as well. A recent study indicates that, in addition to the 648 air-conditioned cars in service in 1933, the railroads of this country have already ordered, or are considering the purchase of, over 2,200 air-conditioning equipments to be installed in passenger cars of all classes during 1934.

The significance of this development can hardly be over-estimated. It means that a bold attempt is to be made to attract and hold passenger traffic from competing agencies and, while the economic justification for such large expenditures for a facility which may be classed as a luxury, is subject to some question, there can be no doubt of the public demand for air-conditioning, nor of the fact that the equipment of railway rolling stock with this modern facility will give employment to many railway men, as well as to employees of equipment and supply manufacturers.

One factor which deserves particular attention in any study of air-conditioned equipment is the question of car insulation, since, unquestionably, present insulation is inadequate, in many instances, to meet the requirements of an efficient system for maintaining desired car temperatures at minimum cost. The possibilities of the various types of insulating media should be studied with the greatest care to assure the use of those adapted to the special requirements of particular installations. In the case of new cars, the added ½ in. or more of insulation thickness, considered necessary for use with air conditioning, could probably be provided at little extra labor cost and not over $75 increased cost per car for material. With existing equipment, the tearing out of interior finish and applying additional insulation to car sides, ceiling, air ducts, etc., may amount to $2,000, more or less, per car, largely for labor. In considering this cost, however, the important thing to remember is that the additional insulation contributes to passenger comfort and reduced cost of operation, summer and winter, throughout the life of the car. In other words, it is a paying investment.

A suggestion which will interest railway men at least was advanced recently by a keen student of modern trends who waxed highly enthusiastic about the pos-

sibilities of general air-conditioning and said that manufacturers of air-cooling apparatus adapted for use not only in rolling stock but also in industrial plants, office buildings, hotels, homes, apartments, etc., could well afford to make railway installations free of charge, in view of the favorable publicity and attendant demand for general air-conditioning. Certainly there is some merit to the contention that business men and other travelers who have just left a comfortable train in intolerably hot weather will be rather insistent that office buildings, hotels and apartments to which they go shall be equally well provided with modern facilities which are designed to maintain comfortable indoor atmospheric conditions irrespective of outside weather.

Whether or not this idea is adopted, there can be no question that air-conditioning as applied to railway equipment is being rapidly extended and presents a problem of equipment design, maintenance and operation with which railway officers must thoroughly familiarize themselves.

The Passenger Train Of the Future

The new light-weight, high-speed articulated train units, one of which, of aluminum construction, has already been delivered to the Union Pacific and another of which, of stainless steel construction, will soon be delivered to the Chicago, Burlington & Quincy, have captured the popular mind. They have restored something of the romance which the railroad formerly possessed for the layman, but which more recently has been lost to the newer forms of transportation. The public is thus visualizing a general rebuilding of passenger service and passenger equipment departing completely from time-honored externals and capable of traveling at high rates of speed.

The popular appeal of these radically changed types of equipment is of inestimable psychological value to the railways. Entirely aside from the ultimate soundness of every feature of the new types of equipment, full advantage may well be taken of the opportunity they afford to re-establish in the public mind a feeling that the industry is by no means suffering from hardening of the arteries and is still capable of a certain restrained youthful enthusiasm.

But these types of equipment confront practical railroad men with problems which must be faced coolly and thought through carefully before sound policies can be adopted with respect to the long-time treatment of the passenger-equipment inventory. The major objective of the railways with respect to passenger service and equipment is, first, to stop further attrition of the volume of passenger traffic and get back as much as possible of the traffic already lost; second, to reduce the cost of performing passenger service sufficiently to permit the attainment of the first objective at a profit.

The new materials and types of construction attack the problem of operating costs by the reduction of weight in passenger trains which railway men today generally admit has become excessive. Reduced weight, combined with reduced cross-sectional area and attention to the principles of aerodynamics in shaping the exterior, has permitted the possibility of speeds sufficiently high to serve as an increased rail-travel incentive without developing excessive power demands. In order to effect every possible reduction in weight and to facilitate easy riding at high speeds the articulated type of construction has been adopted. The train thus becomes a relatively inflexible self-propelled unit, well adapted to a particular class of service. This is a complete departure from the customary conception of the coaches as the units and a flexible train consist of universally interchangeable equipment.

If the new train types are as effective in attracting patronage as the popular interest already shown in them would indicate, the railways will ultimately face the necessity of some adjustment between these two conflicting conceptions of passenger rolling-stock design. These adjustments may be made on at least three different bases: (1) The gradual replacement of existing passenger rolling stock with new more or less inflexible train units which depart completely from present standards for interchangeability; (2) the gradual development of new types of cars in coach units, the characteristics of which would be low truck-center, coupler and floor heights and reduced body cross-sectional area; (3) an intensive re-study of design conforming to present dimensional standards, using new materials to reduce weight but designing to withstand the forces encountered in trains in which the new equipment is mixed with the old.

It is not yet clear whether articulated train units will replace existing types of equipment, except for certain specific types of service for which they can be tailor-made. Reduced dimensions are of value in two directions. They decrease weight and wind resistance. These benefits might be attained by the gradual adoption of coach units which depart from present dimensional and design standards. But this involves a new problem of standardization before such equipment can be utilized except in service localized to the owning road. The capital investment in the present passenger rolling-stock inventory, on the other hand, is a factor strongly favoring the perpetuation of present standards as to form and dimensions. Undoubtedly much can be done in replacements along this line to reduce weight and passenger-train operating costs in the future. The ultimate economy, however, may be somewhat less than can be attained by a departure from present standards and the ultimate development of new ones.

One of the outstanding changes which the new types of construction have effected is in the ideas as to power-capacity requirements. Both types of three-unit articulated trains are, or will be, equipped with power plants of 600 hp. nominal capacity and both are expected to develop maximum speeds in excess of 100 m.p.h. Whether this power-plant capacity will prove to be sufficient is a question which can only be answered by experience, as no exact basis of predicting the quantitative effect of streamlining on full size models moving over the ground has yet been established. Whether or not experience justifies the judgment of the designers of these two trains, a power plant designed for a specific train unit can scarcely handle an increase in the number of coaches at schedules based upon a full utilization of power-plant capacity with normal consist. Aside from the matter of the size of the crew, the self-propelled train unit can scarcely be superior to a train propelled by a separate locomotive unit whether the unit be a steam or a Diesel locomotive.

The new types of equipment, whether or not they are perpetuated in their present form, are doing the railway industry an inestimable service in pointing the way toward reduced costs and improved service to the public. In what direction will these possibilities be realized?

THE READER'S PAGE

Tapping Taper Stud Holes

To the Editor:

Taper stud holes in boiler steel plate are ¾ in. per foot taper. This I believe is the most generally accepted practice. I find it not always possible to obtain as good a thread as with straight holes where the whole tap passes through the hole and is not backed out. Many of the taper holes are found to have one or more sections of the thread torn. We have tried various forms of taps, both ground and cut on a lathe, and various numbers of flutes from three to six, some milled so that not more than 3/16 in. of the thread is left. We have also used as a lubricant everything from white lead to several of the highly praised compounds. Still we cannot always depend upon every hole being as good as required. On some sheets this is not so noticeable, while on others purchased from the same specifications the trouble is greatly increased.

Perhaps some of your readers would like to contribute their views on this subject.

Shop Superintendent.

Methods of Counterbalancing Locomotives Questioned

To the Editor:

The extension of the application of cross-counterbalancing locomotives has led to an examination of the present practice, which reveals some interesting facts.

In the first place, the designer, although he thinks he is calculating a dynamic balance, uses the static weight of the back end of the main rod as revolving weight. Of course, this rod should be treated as a mass having a motion of translation combined with rotation about the crosshead pin, and its effect should be computed by treating its weight as concentrated at its center of gyration. The error is in the neighborhood of 140 lb. for a large locomotive.

Next, he probably treats the total weight of the eccentric crank as concentrated at the crank pin and neglects the weight of the eccentric rod. The error due to the former is around 80 lb., and the error due to neglect of treating the light end of the eccentric crank and the effect of the eccentric rod as weights at 90 deg. to the crank pin may be as high as 30 lb. in the 180 deg. weight and 100 lb. in the 90 deg. weight. Then he makes the right-hand and left-hand wheels alike. If computed correctly, there should be a difference that may amount to about 25 lb. in the resultant balance weight and a difference of 5 deg. or more in the angle of its offset.

Because he took too large a weight for the back end of the main rod, he uses too small a reciprocating weight at the front end. Then there is the question of how much of this weight to balance. More about that later.

When the wheels are completed, the balance is to be checked. He finds in his book of rules long formulas involving cos θ and, perhaps, cos 2 θ, which will require a page or more of computation. Then, on the balancing ways the center of the axle has to be established, an arc scribed of a radius to be computed by a formula requiring the diameter of the crank pin to be measured; and, by means of a plumb line, the crank is brought to position at the angle θ from the vertical. Actually all that is necessary to make as accurate a check as possible of the mounted wheels is to subtract from the 180 deg. weight computed for the wheel to be weighted, in the early stages of the design, the amount of the 90 deg. weight of the opposite wheel, and bring the crank to the horizontal position as determined by the quartering gage.

If both wheels are mounted when the balance is checked, it is necessary to make certain assumptions regarding the correctness of the weight on the opposite wheel, whether cross-balancing or simple balancing is sought. We will assume that the wheel is to be checked by itself. The angle of the balance has been calculated to the minute, with no arithmetical mistake, and the wheel has been made perfectly to the drawing; yet the chances are that it will not check, for most wheels are made with different weights of spokes or plate and rim on the two sides of the balance, making the effective angle less than the computed one.

But why cross-balance, anyway? If there results any reduction in dynamic augment, the decrease is accomplished by reducing the percentage of reciprocating weight balanced. Cross-balancing does not lessen the longitudinal disturbing forces. When the percentage is dropped from 50 to 31.5, the force setting up fore-and-aft oscillations is increased by 37 per cent, if the added weight is placed opposite the crank pin. But it will probably be placed on the center line of the offset weight computed for the revolving weights. In that case the longitudinal force will be increased more than 37 per cent. This would be serious in some service.

The reduction in percentage lessens the dynamic augment, of course, but if simple balancing was followed, and the weight added for the reciprocating masses was so applied that the dynamic augment would be the same on all wheels, the augment with the 50 per cent weight would often be about what it would be for 31.5 per cent and cross-balancing, while the longitudinal force would not be increased. Cross-balancing decreases the forces tending to cause nosing, but that seems to be a minor consideration with long, heavy modern locomotives.

The wheels are completed and placed under the engine. It is expected that the riding of the engine will be the practical test of his work, but good riding is only one of the objects sought in counterbalancing. Riding, too, is affected by the condition of the track, the freedom of the boxes, the springs, the maximum angularity of the main rod, the total steam pressure on the piston, the steam distribution, the weight and travel of the valve, the valve gear, the amount and location of the spring-supported weight of the engine, the kind and condition of the tender buffer, the weight of the tender and its load, the weight of the train and particularly of the head-end cars, the draft gears of the tender and the head-end cars, the speed, and even the time interval since the riders had dinner.

Surely this subject should be better understood.

G. E.

With the
Car Foremen and Inspectors

Train Inspection— In Yard and en Route*

By A. A. Lauer†

ON the Southern Pacific we work on the principle that the best way to avoid trouble is to remove the fundamental causes and do so by stressing the need for thorough conditioning of triple valves, tight brake pipes, painstaking leakage tests by enginemen, testing of retainer valves at designated points, correct piston travel, close attention to draft rigging and air hose, careful education of enginemen in the handling of air brakes and constant attention to those numerous other details of maintenance and operation which have a vital bearing upon avoidance of stuck brakes, break-in-twos, slid flat wheels and damage to brake rigging.

Our principal yards are located about 500 miles apart. Cars arriving and departing in those yards are placed in thorough condition and, as a rule, require very little attention at intermediate points. As a train arrives in yards where car inspectors are employed they station themselves where they can give entire train a careful rolling inspection. Rush cars are usually blocked at the head or rear and are given first attention by inspectors for prompt release to yardmen. When inspection is completed and bad order cars tagged, the cars are then turned over to the yardmen for switching. In some yards it is found advisable to have traveling carmen make the rounds of the industrial, team and house tracks to effect minor repairs so as to avoid having to take to the rip track numerous cars requiring light repairs or delay outbound train while making the repairs. When trains are made up, the usual inspection is made in accordance with I. C. C. regulations and general practice. Trainmen are required to look train over to see that hand brakes are released and assist carmen in making rolling inspection as train departs. We have no hump yards with depressed inspection pits as the volume of traffic through any one yard is not sufficient to justify the investment. Standing inspection of freight trains is made every 50 to 80 miles in open country and, as a rule, coincides with water stops. Stops are made at intervals of 7 to 10 miles on heavy descending grades to permit wheel heat to equalize. Inspection is made at such points by trainmen. On these heavy grades where view is obscured we require a trainman to ride on rear of the caboose to watch the track for indications of derailed wheels, and by night we light the track to the rear of these trains with two inspectors' lanterns. We make a standing air brake test before descending heavy grades and give the train a rolling inspection at every opportunity when stops are made. In snow shed territory we make use of electric reflector type lights, permanently located on foundations at the wheel level and facing the track to aid trainmen in making rolling inspection. These lights are actuated by track circuits as trains approach and depart. Trainmen are required to ride on top of trains to change retainers as required and to watch for overheated wheels, excessive fire flying or other indication of trouble. In certain districts where operating conditions are especially difficult, such as through snow shed territory, we make use of emergency air hose cut in between cars and extended to top of train so that trainmen may apply air if an emergency arises and his stop signal can not be seen. We have discontinued requiring that a proceed signal be passed from rear to head end passing stations or open telegraph offices as we found it impracticable. We require agents, operators and trackmen to watch trains in passing and to signal trainmen when occasion requires.

Generally speaking, we use carmen to inspect trains about every 250 miles. Whenever possible, trains hold the main track at intermediate division points located every 100 to 125 miles and, as a rule, there are no car inspectors at those points. Trainmen of inbound crew make standing inspection and outbound crew makes rolling inspection as train arrives and again as it departs. Passenger trains are also inspected by carmen about every 250 miles. Lids of journal boxes are not lifted unless there is indication of heating. Oil is added about every 500 miles. Passenger trainmen are required to patrol train at regular intervals while in motion and to watch train around curves and through deep cuts to the best advantage to detect evidence of hot boxes or other trouble.

With the foregoing presentation of what is done to condition equipment, operate and inspect it, the question as to what results are obtained naturally arises.

Our records show we are remarkably free of accidents which may be traced to the quality of our train inspection but that on the contrary, both carmen and trainmen, including the enginemen, render a good account of themselves in detecting trouble at its inception and taking necessary action to prevent serious results. I think you will agree with me regarding this when I tell you that during the first seven months of this year we made 315 million freight car miles and 60 million passenger car miles, or a total of 375 million car miles, with record as follows of train accidents in any way traceable to failure of carmen or trainmen properly to inspect equipment or to place cars in safe condition to complete trip after defects were discovered:

- 2 cases of journals burned off.
- 1 case of steam shovel not properly loaded and shifted en route.
- 3 cases of brake beams down.
- 1 case of bottom rod dropping.
- 1 case of arch bar failed at old defect.
- 5 cases of wheels broken account overheating.
- 1 case of car derailed entering siding account vertical flange.

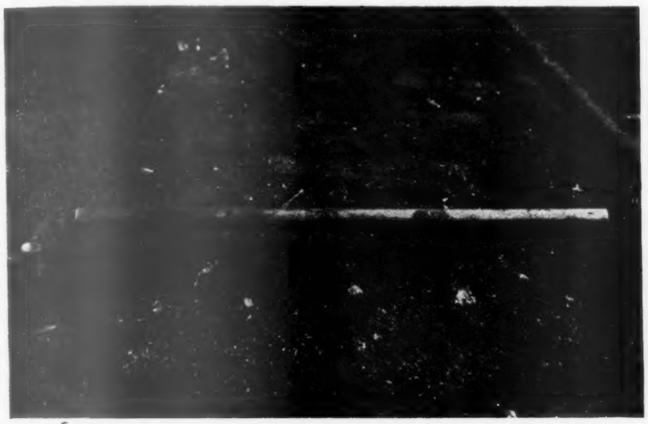
A total of 14 cases in seven months, or an average of 26,785,000 car miles run per reportable defect which employes failed to detect or properly care for. With an average of only two such failures per month in operating over some 9,000 miles of trackage we feel reasonably satisfied with our procedure but recognize the fact that eternal vigilance is the price of safety.

* Abstract of a paper presented at the annual meeting of the Safety Section of the National Safety Council.
† Supervisor of transportation, Southern Pacific.

An Improved Dolly Bar

THE dolly bar shown in the illustration was designed for bucking center-plate, body-bolster, diaphragm and center-sill cover-plate rivets. The bar is held horizontally and the extension from the handle acts as a lever for holding the rivet in place. The carman merely raises up or bears down on the bar and because of its weight the rivet is firmly held.

The bar is made of 1¾-in. specially treated tool steel and is 38 in. long. Because of the weight it eliminates much of the shock received when using lighter type bars and once its use is adopted the riveting gangs prefer it to other types of dolly bars.



A dolly bar for center-plate and cover-plate rivets

Protector for Yard Steam-Heat Connector

WITH the elimination of steam hose for yard-line connections in coach yards and passenger stations, steam lines equipped with metallic connectors were installed. Many car inspectors have been painfully burned while attempting to connect or disconnect the yard lines to passenger trains on account of the pipe connection becoming hot from the steam.

This condition can be eliminated by applying a piece of steam hose or other heat-resisting tubing on the end of the connector, just behind the coupling as shown in the accompanying illustration.

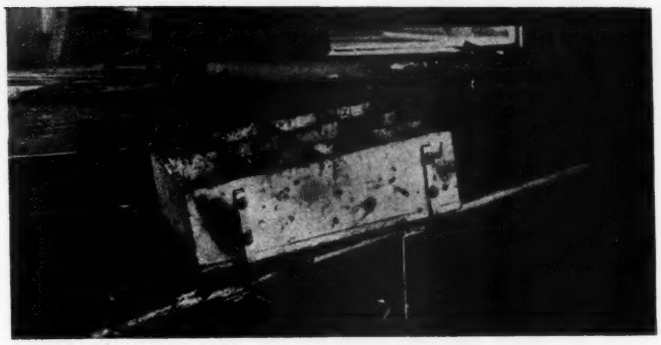
Safety protection on a yard steam-heat connection

Portable Tool and Rivet Containers for the Car Shop

FOR the car foreman who objects to seeing dolly bars, rivet sets and other tools lying around the ground in the steel car shop and finds it inconvenient to have six or eight different containers setting around each rivet forge in the shop, the two portable containers herein illustrated will be found of particular interest. One is a wheelbarrow container for dollies and the other a portable rivet container which is divided into a number of compartments.

Each rivet container is divided into eleven compartments, the size of which is governed by the size and quantity of rivets used. If a riveting gang were assigned to drive underframes on box cars, the container would be filled with only 1-in., ⅞-in. and ¾-in. rivets. But if one were assigned to a job where the majority of his work required the use of ⅝-in. rivets, he would naturally supply himself with rivets of that size. The container eliminates the unsightly appearance of many special containers and reduces to a large degree the number of rivets left lying around on the ground.

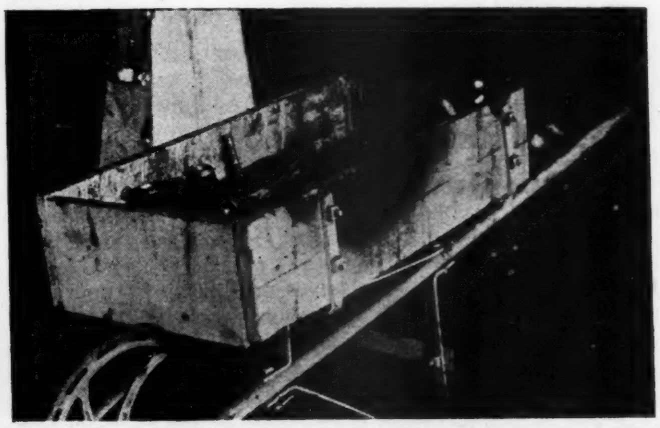
A block attached to one side of the box of the tool wheelbarrow provides a place to insert the various sizes



A portable rivet container for the riveting gang

of rivet sets and drifting pins and the balance of the box has a flat bottom which permits the dolly bars to lie flat, making it possible to select the type of bar needed without disarranging the entire outfit.

The frame of each wheelbarrow is made from 1¼-in. pipe, at one end of which is attached a 12-in. wheel. The body of the tool container is made of 1-in. pine, 36 in. long, 18 in. wide and 7 in. deep. The body of the rivet container is made of the same material, 24 in. long by 18 in. wide and 9 in. deep.



A tool wheelbarrow for the riveting gang

Pneumatic Rivet Buckers

THE construction of many of the freight cars today have indicated much sill damage is being experienced because of the fact that sill and underframe rivets are not being driven tightly which permits the sills to shift and the rivets to shear off when the cars are handled in 100- to 150-car trains. The average carman pays little or no attention to whether a rivet is driven sufficiently tight to withstand a hammer test for tightness and while an inspection of the rivet head would indicate to the casual observer that it was tight the chances are that many of them are really quite loose. This condition re-

Pneumatic rivet bucker for use between center and draft sills

sults in many failures due to the sills buckling under extreme pressure or to breaking of diagonal braces or end sills.

Many loose rivets occur because the bucker fails to secure a good leverage on the rivet head before the rivet is driven. To overcome this cause one car foreman provided his riveting gangs with the pneumatic bucker which is shown in the accompanying illustration. It is used between the center or draft sills and will hold all rivets in place tightly while they are being driven. It is made from a 6-in. cylinder with a 5-in, piston to which is inserted the proper size rivet set. A pipe of sufficient length to permit its operation between the sills is provided and an ordinary cut-out cock is attached. A 3/8-in. hole is drilled through one side of it to permit release.

Handling Explosives*

By E. J. League†

THE Bureau of Explosives has been in operation since 1907. In that year there were 101 deaths, 62 injured, and a property damage or loss of $496,280 just on explosives alone. Those figures did not include the other dangerous articles such as gasoline, acids, poisonous articles or inflammable solids. To go back that far tonight is too much to tackle so let us take the last 15 years and see what the picture looks like.

Fig. 1 includes both the explosives and all the dangerous articles and shows the number of persons killed in 1918 to be nineteen, gradually coming down to 1932, last year, when there were no fatalities whatever. Compare this 15 year record with that of 1907 with 101 deaths.

The middle section of the chart shows the number of persons injured during the past fifteen years, running from 106 in 1918 down to but 19 in 1932. Comparing that with the 62 injuries in 1907 is quite a drop and one that we all can be proud of.

The top section of the chart shows the property loss which starts off in 1918 with $1,600,000. That amount drops gradually until 1932, the total property loss is $373,000. Comparing that amount with $496,820 in 1907, it doesn't at first glance, look so well, but the 1932 figures include all the explosives and the other dan-

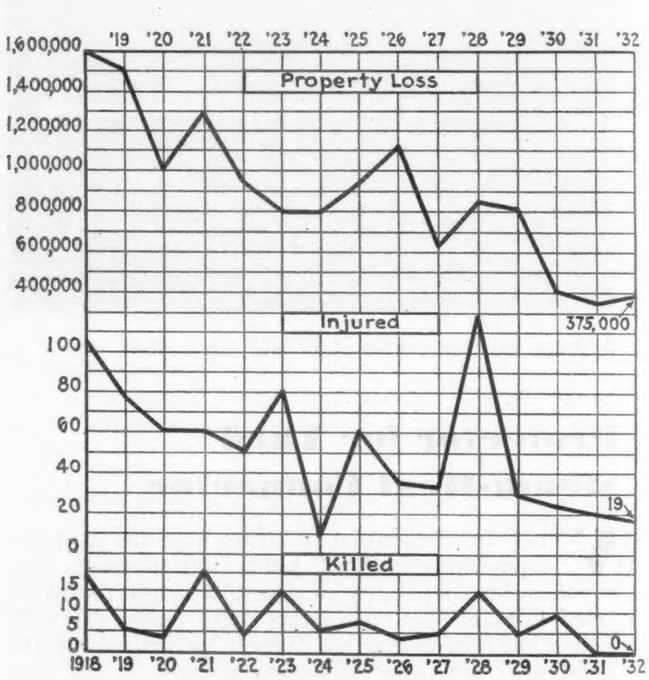


Fig. 1—Loss in railway handling of explosives and all other dangerous articles

gerous articles as well, while the figures for 1907 were for just the explosives. The loss for 1932 on just explosives was only $27, so we can still point to the record with a great deal of pride.

While we are talking figures, let us dig into just a few more and then we will be through with figures. Take, let us say, a 10-year period—the last 10 years—and average the total property loss for one year. Then let us tear that yearly average apart and see just what particular class of this dangerous freight gives us the most trouble and why.

This next chart (Fig. 2) is not a "baloney dollar" but a mightly effort on my part to draw you a picture of a 33-in. car wheel. Usually such illustrations are represented merely by a circle but, in compliment to your association, I chose the car wheel. As shown in the center, the wheel represents a total of $713,000, the average yearly property loss for each of the past 10 years. Splitting that amount up into the several different classes of Dangerous Articles we find the following:

* Part of an address presented at the Chicago meeting of the Car Foremen's Association of Chicago.
† Inspector, Bureau of Explosives, Chicago.

1.5 per cent, chargeable to explosives; 2.7 per cent, acids and corrosive liquids; 83.33 per cent, inflammable liquids; 9.7 per cent, inflammable solids; 1.1 per cent, compressed gases; .03 per cent, poisonous articles; 1.4 per cent, semi-dangerous commodities.

From this chart one can readily see that inflammable liquids are responsible for 83-1/3 per cent of our total property loss and, I dare say, 90 per cent or more of that volume was in tank cars. We must not, for a single minute, let up in our efforts to properly handle all classes of this dangerous freight for a single accident to a car of explosives or to a car of chlorine gas could easily cause enough property damage to equal this total of $713,000 in itself. So without letting up on those smaller percentages, we must give more, much more attention to the inflammable liquids, most of which, of course, move in tank cars. It is not my purpose to tell you how to do that. There are rules in your department and in the I. C. C. regulations, most of you know them as well as I do. I just want to impress you with where the most of our trouble lies.

Now let us take this same total of $713,000 and break it up another way, this time showing the percentages due to the different causes. This next chart (Fig. 3) is another 33-in. car wheel which in its entirety represents the average yearly loss each year for the past ten years. Starting at the top we see that 3 per cent was chargeable to negligence of employes. Isn't it a source of satisfaction to see that proportion the smallest of them all? Following around the wheel we find the other proportions are: 4 per cent, rough handling; 4 per cent, loading methods and containers; 81 per cent, wrecks and derailments; 2 per cent, spontaneous heating or excessive sensitivity; 6 per cent, miscellaneous and unknown causes.

Let us group the negligence of employes, rough handling, and loading and containers, a total of 11 per cent.

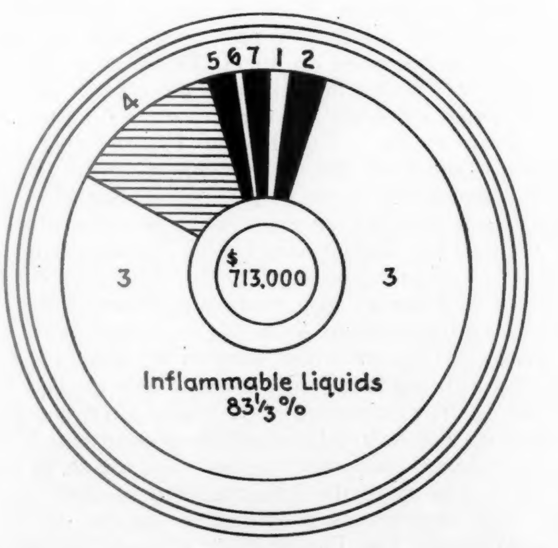


Fig. 2—**Proportionate average yearly property loss due to various causes**

All of us are familiar with the great efforts put forth by the carriers to educate employes by bringing them together in meetings similar to this where they can exchange experiences and they themselves suggest different and improved ways of doing things. We listen to speakers who have specialized in some particular branch of railroad work such as the Freight Claim Division of the A.R.A. or the Container Bureau. We have air-brake and other instruction cars. The Bureau of Explosives has been, and still is, constantly working on improved containers for these dangerous articles and policing their use.

Our chemical laboratory is perhaps the only one of its kind in the world and the results of their tests are acknowledged the country over as authority. Their many tests on spontaneous heating have brought about a large number of changes in the manufacture of many com-

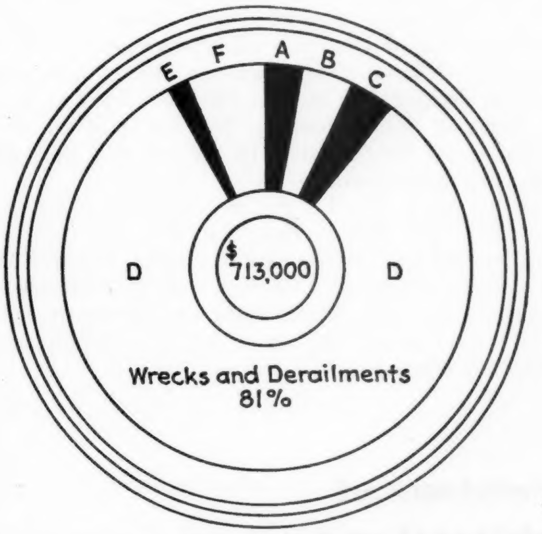


Fig. 3—Proportionate causes of the average yearly property loss of $713,000

modities, different methods of packing and some of them prohibited entirely from transportation by rail.

Let me give you some illustrations of our investigation work in cases of spontaneous heating. If I were to tell you that we have had fires in sandpaper, peanut skins and burnt popcorn, you might believe me but you would perhaps be inclined to think it was deep stuff and let it go at that. Let me try to explain it so that you will see that it is as simple as a, b, c.

In one of our Chicago yards we had a fire in a carload of sandpaper, the cause of the fire not being apparent so anybody's guess was good. The first thing usually given in cases like that is "sparks from an outside source." That seemed reasonable for whoever heard of sandpaper starting a fire unless you struck a match across it?

The rolls of sandpaper were examined and it appeared that the fire started inside the rolls and burned outward. A five-pound sample was sent to our laboratory and they found that after the paper had been coated with sand, it had been treated to a mixture of chinawood oil and linseed oil. Apparently, the oil mixture had not been given sufficient time to dry. When tightly packed, as in a roll, it began to heat. A simple explanation or comparison would be rags soaked with linseed oil and wadded up in a ball. We all know the likelihood of fire from such rags and, you remember, rags go into the manufacture of paper. As a result of our tests, the manufacturer of the sandpaper changed his methods and, so far as I know, there have been no more fires.

Another interesting case, that of peanut skins sometimes called peanut bran. Large candy companies remove the thin skin from the kernel before putting it into their candy bars. These skins are sold to fertilizer factories who put them under great pressure and squeeze out the oil. The residue is used as a fertilizer. The skins are usually packed by the candy people in jute bags or gunny sacks of about three bushels each. The material is so bulky for its weight that to get the minimum

into a car, it must be jammed up tight to the roof. This large bulk and tight packing do a miniature job of squeezing out the peanut oil and the oil together with the gunny-sack material tend to favor spontaneous heating and, if conditions are just right, we can have a fire. Of course, the shipper says "sparks from an outside source."

Just another illustration, that of some four or five fires in waste cracker-jack. Stale cracker-jack, floor sweepings and partly popped grains of pop-corn were bagged up in gunny-sacks and shipped to nearby farmers for hog-feed. Samples were examined and our laboratory found that the partly popped grains were scorched and liable to spontaneous heating when loaded in tightly loaded box cars. The remedy was to store this material before loading for about a week so it could cool off by exposure to the air and thus greatly reduce the fire hazard.

[At this point, Mr. League discussed the large proportion of loss and damage due to wrecks and derailments, which he said may be charged in general to three causes, man failures, equipment failures and track failures. He emphasized the educational work and the many research activities now under way in an effort to minimize these failures.—EDITOR.]

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Car Damaged-Owner Responsible; Failure to Control Moving Cars

The Shell Petroleum Corporation delivered a loaded tank car in O. K. mechanical condition to the Indiana Harbor Belt. The car, while standing at the head of a cut in the railroad's classification hump yard at West Gibson, Ind., was struck by another rapidly moving tank car which was also loaded, although listed as an empty car. While the damage to the moving car was comparatively slight, the standing Shell Petroleum Corporation's car, although not derailed, was badly damaged. Center sills were bent down, spread and split open from the bolster to the end; draft lugs, buffer, carrying iron, coupler, draft gear, yoke, cross-key and other parts were broken or missing. The car was returned (loaded) to the owner with request for a defect card through Chicago Interchange Bureau inspector, which was declined, but a joint inspection certificate was executed. A defect card was, however, subsequently issued for missing coupler, draft gear, yoke and cross-key under Rule 95. The Shell Petroleum Corporation contended that the railroad was responsible for all damage to the car under 1931 interchange Rule 32, section d, paragraph 5, because the I. H. B. erred in listing the moving tank car as empty when it was actually loaded and consequently failed to control its speed properly by the car retarding device. In support of the contention of improper handling in switching, evidence was submitted showing that the cross-sectional area of the center-sill construction was 43.98 sq in., whereas the A. R. A. requirement is only 30 sq. in. The railroad contended that the damage was confined to the A end of the car between the body bolster and the end of the car, and that section 5 of Rule 44 specifically provides that such damage shall be considered owner's responsibility provided car was not subject to unfair handling as outlined in sections a, b, c, e, f, m and o of Rule 32. Inasmuch as the car in question was not subject to any of these conditions, they contended that Rule 44 was not applicable and owner was responsible.

In a decision rendered April 7, 1933, the Arbitration Committee ruled that: "Paragraph 5, Section (d), Rule 32, 1931 Code, reading 'Failure to properly control moving cars with car-retarding device,' applies only where damage to one of the first three cars in moving cut, or one of the first three cars in standing cut, results in a combination of defects as outlined in Rule 44. This is an arbitrary measure adopted to define unfair impact in switching, without regard to whether or not a car may meet the A. R. A. strength requirements. It also serves as the means of determining whether or not car was improperly controlled by the retarding device. Therefore, since the damage to car in question did not form a combination of defects as outlined in Rule 44, and as no evidence is presented to show that the car had been derailed or unfairly handled under any of the other conditions of Rule 32, the car owner's contention is not sustained."—*Case No. 1723, Indiana Harbor Belt vs. Shell Petroleum Corporation.*

Billing Repair Card Altered After Rendition of Bill

The St. Louis-Southwestern applied two new cast-iron wheels to a Pacific Fruit Express car at Pine Bluff, Ark., and submitted a billing repair card showing that the wheels were mounted on an 80,000-lb. axle with wheel seats $6\frac{5}{8}$ in. The same road also applied a set of wheels to another P. F. E. car at Shreveport, La., and submitted a billing repair card showing that the wheels were mounted on an 80,000-lb. axle with wheel seat $6\frac{7}{8}$ in. Both wheel changes were made on account of car owner's defects and charges were for new wheels, less scrap credit. The Pacific Fruit Express, after checking, returned the billing repair cards and wheel statements to the railway, requesting that charges for new wheels mounted on axles with over-size wheel seats be reduced to second-hand value in accordance with Rule 98, interpretation 5. The St. Louis-Southwestern declined to make an adjustment and returned the papers after changing them to show $6\frac{1}{2}$-in. wheel seats on the first car and $6\frac{7}{16}$-in. wheel seats on the second car, these dimensions being standard for the wheels applied. These alterations in dimensions were made after checking to agree with the railroad's wheel-shop records. The railroad explained that the changes were made to correct errors and to make the bills conform to their carefully kept shop records, as provided for in the Wheel and Axle Manual. The Pacific Fruit Express, on the other hand, contended that it was against the principles of interchange rules to make alterations in billing papers after they had been checked by the car owners.

In a decision rendered April 7, 1933, the Arbitration Committee ruled that: "As repairing road failed to avail itself of the opportunity of checking dimensions of axle with wheel-shop records prior to rendition of bill, the dimensions shown on billing repair card should govern. Charges should, therefore, be reduced in accordance with Rule 98, interpretation 5."—*Case No. 1722, Pacific Fruit Express Company vs. St. Louis-Southwestern.*

In the Back Shop and Enginehouse

Making Tank Hose Connection Gaskets

By A. Skinner

DISCARDED steam-heat hose unsuitable for further service can be utilized by cutting them into gaskets for tank-hose connections at relatively little cost by the use of the shop-made devices shown in the illustrations. These gaskets are required in 11 different sizes on one large railway system, as shown in the table, and can be made at the rate of about 500 gaskets per eight-hour day, dependent upon the size, using the equipment illustrated.

Table of Standard Gasket Sizes and Corresponding Cutting Tool Dimensions*

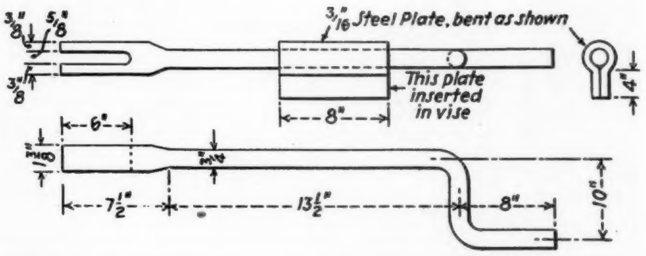
Gasket size	A	B	C	D	E
3⅝ by 2½	⅜	9/16	2 7/16	9/16	4⅛
4¼ by 3⅛	⅜	⅝	3⅛	⅝	5
4⅛ by 2 13/16	7/16	11/16	2¾	11/16	5
4¾ by 3⅝	3/16	9/16	3 5/16	9/16	5⅛
4¾ by 3½	¼	⅝	3½	⅝	5 1/16
4⅛ by 3	½	9/16	3	9/16	5⅛
3¼ by 2 13/16	7/16	9/16	2 3/16	9/16	4⅛
3¾ by 2½	⅜	⅝	2½	⅝	4½
3⅝ by 2⅝	¼	½	2⅝	½	4 3/16
3¼ by 2⅛	5/16	9/16	2⅛	9/16	3 15/16
3¼ by 2 3/16	15/16	¼	2 13/16	¼	5 3/16

*All dimensions shown in inches.

The first operation, after removing the hose clamps and fittings, consists of splitting each hose lengthwise, using a special jig and parting tool in an ordinary shaper. The parting tool is ground to a sharp edge and the jig, held in the standard shaper vise, consists of a base plate, 45 in. long by 4¾ in. wide by 2¾ in. high, slotted along the center line to receive a ¾-in. round holding rod which is pivoted on a bolt at the shaper end of the jig and held down by a small hand lever at the other end.

The hose to be split is simply inserted over this holding rod which is then swung down parallel with the base plate, compressing the hose slightly into the groove and holding it securely during the splitting operation. The stroke of the shaper is adjusted to the required length and the hose is split in one operation of the machine.

Special holding jig as used in a shaper during the hose-splitting operation



Details of the vise-supported crank used in rolling hose

After the hose is split, it is rolled on the device shown in the second and third illustrations. This consists simply of a crank made of ¾-in. stock with a handle on one end and a slot on the other to receive the hose, the center bearing for the crank consisting of a $^3/_{16}$-in. steel plate, bent, as shown in the illustration, and firmly supported in the jaws of a bench vise. One end of the

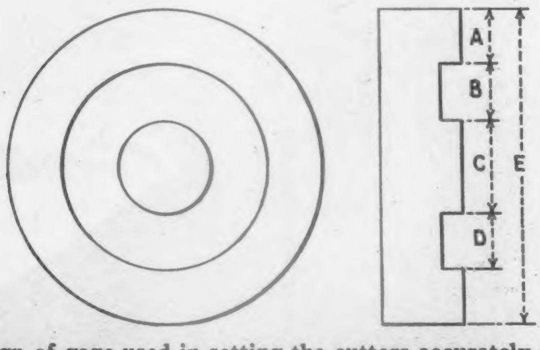
Crank device used in rolling and wiring hose preparatory to soaking them in a vat of boiling water

hose is simply entered in the slot, the operation of the crank winding up the hose, which is then wired and slipped off without difficulty. The object of this operation, including the wiring of the hose, is simply to hold it in a coil while immersed in a tank of boiling water, which tends to facilitate holding the hose flat while cutting the gaskets. Immersion of the hose in a tank of hot water for a few hours is usually adequate to accomplish this result.

In cutting the gaskets, a drill press is employed, utilizing a wood block arrangement and clamping device

Method of cutting tank hose gaskets using a special drill-press jig and adjustable cutter

which holds the hose flat while the gaskets are being cut with a special tool. This hinged holding device consists simply of a small bracket and eye bolted to the drill table and a hinged steel ring with 4½-in. inside diameter to accommodate the largest gasket. A rubber handle on the outer end facilitates holding the hose in a flat position while cutting the gasket. An adjustable three-bladed cutter, shown in the illustration, is used for the actual cutting operation, this cutter consisting of a horizontal bar firmly held in the drilling machine spindle and provided with one center cutter and two outside



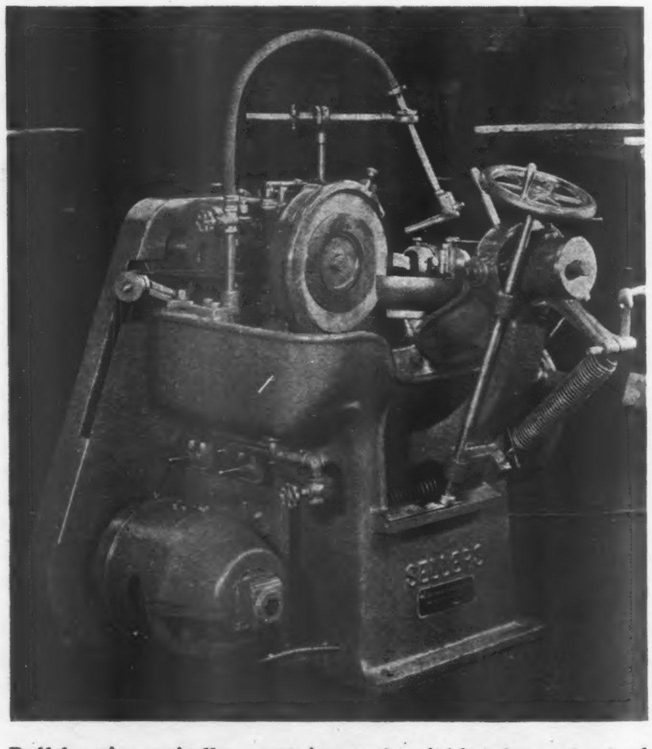
Design of gage used in setting the cutters accurately so as to produce standard gasket sizes, as shown in the table

cutters with screw adjustment along the bar. To save time and assure accuracy in the gaskets cut, 11 gages, of simple design and made to the sizes illustrated, are used in setting the cutter blades. All of the devices described in this operation are shop-made, with the exception of the adjustable cutter, which is of special design and apparently requires special steel cutting tools for the best results.

Improved Grinder for High-Speed Tools

THE new No. 2A tool grinder made by Wm. Sellers & Company, Inc., Philadelphia, Pa., is a completely redesigned and modernized machine, built to meet the exacting requirements for grinding cemented-carbide as well as high-speed steel tools. A most important change has been made in the spindle construction. Elimination of vibration or looseness of the spindle is essential in grinding cemented-carbide tools because this material is so brittle that it will chip unless the wheel is free from vibration or lost motion. For this reason a special pre-loaded ball-bearing mounting has been substituted for the plain bronze bushing in the earlier model.

The method of driving the spindle has been modernized, a V-type belt with the pulley mounted close to the bearings now being used instead of the former flat belt with greatly over-hung pulley. The axial oscillation of the spindle has also been improved. On the old machine this was obtained by an unprotected cam which caused



Ball-bearing spindle mounting and quickly changed wheel have been adopted on Sellers No. 2A grinder to meet conditions imposed by modern cemented-carbide and high-speed tools

the spindle to move back and forth in its own bearings. Now the spindle, with its pre-loaded type ball bearings, is mounted in a large bronze sleeve which is oscillated axially by a protected cam revolving at a fixed speed and arranged with a heavy coiled spring to keep the sleeve and cam in positive contact.

The whole grinding head has been designed for lubrication by a high-pressure grease gun system. This method, besides providing better lubrication, also keeps abrasive dust from working into the bearings. Back lash has been eliminated from the feed screw which acuates the in-and-out movement of the chuck. This has been accomplished by a heavy spring which insures positive contact between the nut and the screw. The wheel guard has been modified so that now it can be

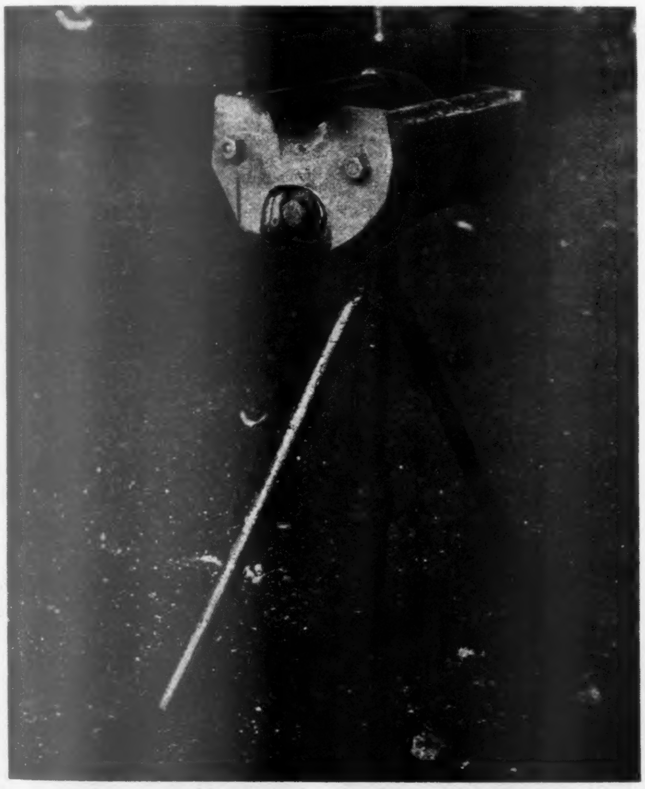
readily removed after merely loosening one knurled nut. This is particularly advantageous where both cemented-carbide and high-speed steel tools are being ground on the same machine, because grinding wheels can be interchanged rapidly. The motor is no longer carried on a base plate but is mounted on the side of the machine and is arranged with a convenient adjustment for the main drive belt tension.

The holder is designed to take tool shanks up to $1\frac{1}{2}$ in. by 2 in. The drive is furnished by a 3-hp. a. c. or d. c. constant-speed motor. The net weight is 2,770 lb. and the floor space occupied is 4 ft. 8 in. by 4 ft. 6 in.

Furnace For the Pipe Shop

In order to make a satisfactory bend in steam and airpipes applied to locomotives in the back shop the pipe must be properly heated where the bend is to be made. Usually it is necessary to heat the pipe several times to effect a good job and where this is done on other than a special forge the job is somewhat difficult.

It is assumed that in the majority of the roundhouses and backshops natural or artificial gas is available and



Portable pipe-bending furnace

if connected properly can be used more efficiently and is less costly than fuel oil or coke forges for performing this operation.

The forge shown in the illustration is made from a hollow cast-iron block with numerous $\frac{1}{16}$-in. holes drilled inside. The operating valve, mixing the gas and air, is located a short distance from the forge to eliminate any hazard to the mechanic lighting it off. After a good heat is established it only requires a few minutes to heat the pipe sufficiently to make a satisfactory bend in it.

Unique Type of Turntable Drive

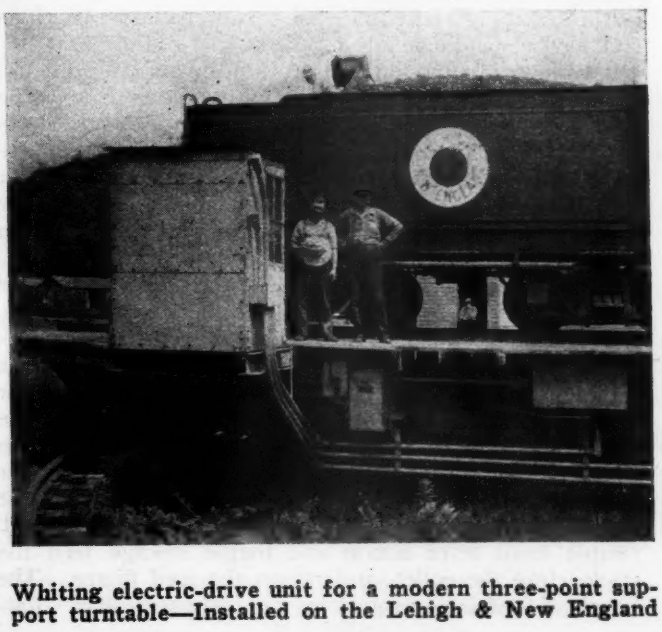
When the Lehigh & New England lengthened its locomotive turntable at Martin's Creek, Pa., a little over a year ago, the table was converted from a center support to a three-point support, extensions being made at each end of the table. The location of the trucks remained unchanged, making it possible to leave the circular track undisturbed. The original length of the table was 80 ft. and equipped with four wheels at each end.

The drive for this table was furnished by the Whiting Corporation, Harvey, Ill. It consists of two separate units, one for each end of the table, the arrangement being the same as the bridge drive used on the Whiting Tiger crane, with the exception that spiral gears and pinions are used at each truck gear reduction, because of the truck-wheel axles being radial to the table's center bearing and the drive shaft parallel with the table girders.

Two 20-hp. motors provide the power and give the turntable a speed of 100 ft. per min. Duplex control is used, located in the steel cage placed at one end of the table. The cage also includes the foot-brake and other operating equipment. The power is applied to only one truck wheel at each end of the table. These wheels, equipped with M. C. B. type truck brakes, are lowered slightly from their former position, in order to provide the necessary traction. The remaining wheels of the trucks required no changes.

The illustration shows the cantilever extensions added to the ends of the table. The housing containing the motor is shown just below the front tender truck. The two housings below the front wheel of the rear tender truck protect the reduction gears and the foot-brake. The drive shafts are clearly shown. A similar unit is located on the opposite side near its other end.

With this arrangement, it was found possible readily to install a powerful unit without disturbing the end construction of the girders, and so locate the mechanism that it was readily accessible for inspection and repairs. There being no limiting dimensions for unit size, no expensive special additions were necessary to reduce friction as a compensation frequently necessary when driving mechanism mounted directly on trucks must be made purposely small for lack of space.

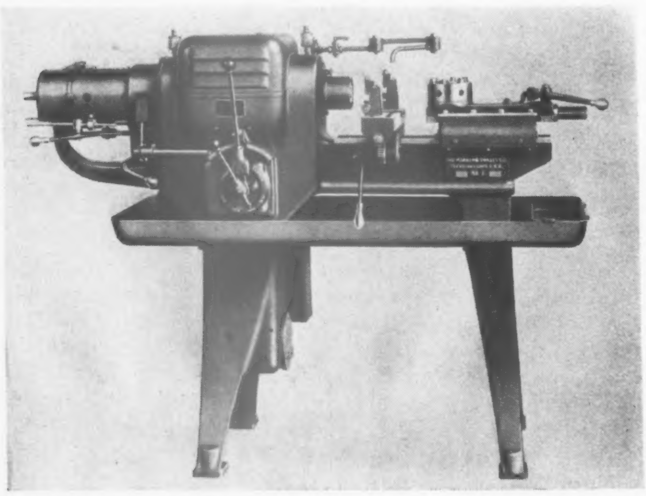


Whiting electric-drive unit for a modern three-point support turntable—Installed on the Lehigh & New England

High-Speed Electric Turret Lathe

A HIGH-speed turret lathe, with its motor built into the head of the machine, and new bar feed, has recently been brought out by the Warner & Swasey Company, Cleveland. The new lathe is designed for higher cutting speeds, which are becoming increasingly desirable, especially when carbide or diamond cutting tools are employed, and is particularly adapted to small diameter work and non-ferrous materials, where high speeds necessitate very high spindle revolution.

The machine is said to incorporate for the first time a completely self-contained alternating current motor drive; the rotor is mounted directly on the spindle, while the stator is in the head housing. Four speeds are available in either direction; 600, 1,200, 1,800 and 3,600 r. p. m. All gearing and belts are eliminated, resulting in a simple construction that provides ample power, free from trouble and excessive frictional losses. Perfect balance is easily obtained because there is but one rotating unit.



No. 1 electric turret lathe with motor built into head

Overheating is guarded against by fan blades, rigidly attached to the rotor, which circulate a high-velocity air draft through cored passages around spindle bearings and motor windings.

Two levers, responding instantly to finger tip pressure, control the spindle electrically through a drum type controller and automatic relays. The shorter lever selects the four spindle speeds; the longer lever stops, starts and reverses, the spindle being quickly reversed without damage to the motor. A large band brake, actuated by the longer lever in the neutral position, prevents rotation when attaching chucks, loading work, etc.

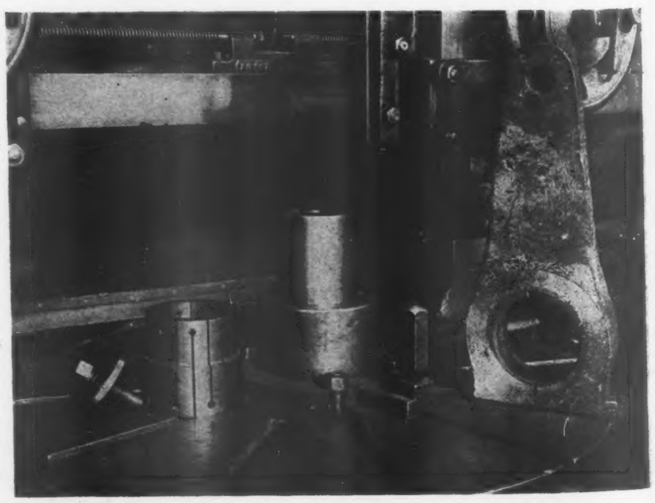
High speeds made possible by the new lathe have necessitated a new combination of bar feed elements. For this purpose a friction finger-bar feed has been developed, holding bars in a concentric position in the spindle to prevent vibration, and enclosing them for their full length in a protecting tube for safety. The friction feed finger lies immediately behind the collet so that bar stock can be used up to the last end. The finger is mounted on a feed tube, which, at the rear of the spindle, is reciprocated by a fork. No cams are used. Simple hand lever action and toggle linkage feed the stock, close the collet, and return the feed finger. The length of feed is controlled by a quickly set collar. Balance at high speed is secured by supporting bar stock in the spindle by a removable filler tube, which prevents excessive runout and vibration. Safety is assured by using a full length stationary supporting tube which reaches nearly up to the feed tube.

Eccentric-Crank Holding Fixture

AN eccentric-crank holding fixture, used at the Silvis (Ill.) shops of the Chicago, Rock Island & Pacific, for facing off the lateral wear surface of the crank square with the crank-pin hole, is shown in the illustration. Eccentric cranks, excessively worn in service by contact with the main-rod bushings, are reconditioned by undercutting the worn surfaces, building up with bronze and re-machining on a boring mill. In order to assure freedom from subsequent heating and as long service life as practicable, it is important to refinish this lateral bearing surface square with the bore of the crank-pin hole, an operation which is greatly facilitated by the use of the device illustrated.

This eccentric-crank holding fixture comprises essentially a substantial base plate and cylindrical block, 9 in. in diameter by 12 in. high, firmly bolted to and accurately centered on the boring-mill table. The upper end of this block is tapered, being 4¼-in. in diameter at the upper end and 6 in. in diameter at the lower end, the length of the tapered part being 6 in. An expanding sleeve with a corresponding internal taper and provided with two step sizes for the accommodation of crank arms with different sized crank-pin holes is illustrated, also the circular top plate and hex-head holding screw. The elongated hex-head nut, shown just at the right of the tapered center post, is simply an adjustable outboard support for the eccentric crank when mounted on the jig in a horizontal position.

In operation, the expanding bushing is placed over the tapered center pin, the eccentric crank applied over the bushing at the appropriate step size, and the top plate and holding screw tightened until the eccentric crank is accurately centered and firmly held in the correct position at right angles to the axis of the boring-mill table. A horizontal cut made with a cutting tool across the eccentric-crank face will then be square with the crank-pin hole.

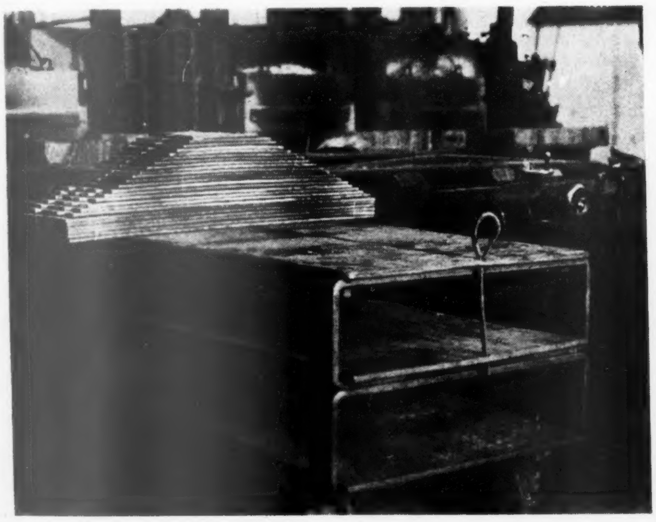


Eccentric crank holding fixture for use in facing the lateral-wear surface square with the crank-pin hole

Trailer for the Spring Shop

THE trailer shown in the photograph is used for handling spring leaves from the heat-treating furnace to the banding machine in sets ready for the banding operation. After the leaves are sheared, punched, formed and properly heat treated they are made up in sets. When the trailer is completely loaded it is moved to the banding machine and sufficient complete sets are available to keep the banding-machine operator busy for some time.

A narrow-gage track is laid between the furnaces and the banding machine at which point a switch is provided to permit the empty trailer being returned on an adjacent track for reloading. The trailer is made from 7/16-in. boiler plate mounted on a 1-in. by 4-in. wrought-iron frame. Roller bearings are used in the hubs of the cast-iron flanged wheels to permit easy movement of the trailer with the weight of the spring leaves on it. The type of trailer shown will permit the handling of 18 spring sets at one time.



A car for moving locomotive springs to the banding machine

Clover-Leaf Grease Press

A SPECIAL hard-grease press is used at a number of shop and enginehouse points on the Chicago, Rock Island & Pacific, being appropriately called the Clover-Leaf press, because of its shape. This device forms a convenient and effective means of applying a cake of hard grease to the perforated copper cellar plate which bears against the journal, sufficient pressure being applied so that the grease is forced through the small holes in the same direction in which it will flow when in service, thus assuring necessary and uninterrupted main journal lubrication when locomotives are first turned out of the shop. This method avoids the present more or less common practice of attempting to fill the perforated plate holes with grease from the outside by means of a hand paddle after the main grease cake has been applied. As a result, the application is not uniform and there is a tendency to create a division in the grease with consequent interruption of the flow of lubricant.

The Clover-Leaf grease press is a bolted and welded steel structure, 60 in. high overall, by 24 in. wide, mounted on supporting legs which are bolted to two floor strips made of 1-in. by 2½-in. steel, 36 in. long. A Buda 25-ton hand jack is welded in an inverted position to the top of the cross rail of the device, being operated by the usual removable round lever or bar. The drum of the machine is 16 in. long on the axis and designed with an exterior surface to accommodate four different diameter sizes of driving-box grease cellars, namely 10-in., 11-in., 11½-in. and 12-in. The drum is a completely-welded structure, made of ¼-in. plate and provided with positioning pins, as shown. By means of two adapting plates, the additional sizes of 9-in. and 12½-in. cellars can also be accommodated.

In operation, a false cellar with the bottom cut out and a perforated plate and hard grease cake inserted, is applied over the proper size segment of the drum. A close-fitting steel plate is put in the false cellar on top of the grease cake and operation of the jack then forces this grease through the perforated holes. With the jack still applied, operation of the upper bar and lever arrangement lifts the dummy cellar by means of the two chains attached to welded lugs, as illustrated. The pressure on the jack is then released and the perforated plate and grease cake removed, being ready for application in the standard driving-box cellar. A generous proportion of the grease has been forced through the perforated holes to the inner diameter of the copper plate which bears against the under side of the journal. The cellar and plate are, therefore, well filled with grease and ready to provide immediate lubrication.

Clover-Leaf press used in forcing hard grease through holes in the perforated copper plates used in driving-box cellars

Among the

Clubs and Associations

New England Railroad Club.—The annual meeting and election of officers of the New England Railroad Club was held on March 13.

Northwest Car Men's Assn.—At the March 5 meeting of the Northwest Car Men's Association, original record of repairs and A. R. A. billing was discussed by George Johnson, chief clerk to master car builder, Northern Pacific.

Southern and Southwestern Railway Club.—T. Sawyer, Diesel Electric Division, American Locomotive Company, presented a paper on Diesel electric locomotives at the March 15 meeting of the Southern and Southwestern Railway Club.

Canadian Railway Club.—"Recent Progress in the Design and Construction of Locomotive, Freight and Passenger Equipment" was the subject discussed before the March 12 meeting of the Canadian Railway Club by a representative of the Pullman Company.

Car Foremen's Association of Chicago.—Meeting held Monday evening, March 12, at the Hotel LaSalle, Chicago. Proposed changes in the A. R. A. Rules of Interchange were considered, the discussion being led by R. A. Forbes, chairman of the A. R. A. Rules Committee and assistant superintendent of the Chicago Car Interchange Bureau.

Prospects of the Railway Supply Industry

Western Railway Club.—Meeting held Monday evening, February 19, at the Hotel Sherman, Chicago; subject, "Prospects and Problems of the Railway Supply and Equipment Industry"; speaker, Samuel O. Dunn, chairman of the board of the Simmons-Boardman Publishing Company and editor of Railway Age. ¶ In this address, the speaker quoted impressive general figures, indicating the magnitude of the railway supply industry, and said that the volume of future purchases will depend upon railway gross and net earnings as influenced by government policies and the revival of general business. He called attention to the difference between the capitalistic and the socialist-labor philosophies, and said that the latter is now apparently dictating the economic policies of the national government. Assuming that the rights and interests of wage earners are not to be permanently treated as entirely paramount to those of investors and business men, Mr. Dunn said: "There is, in my opinion, no reason for doubting that, in the absence of excessively socialistic and restrictive government economic policies, the total volume of production and commerce in this country will again expand until, within a few years, it will exceed all previous records. It also seems probable that government policies will be adopted which will greatly reduce present inequalities in the conditions under which the railways must compete with other agencies of transportation. In that case the railways will be confronted with the necessity of both rehabilitating their properties and of so improving them as to enable them to nullify the advantages now enjoyed by their highway competitors which are due to the physical characteristics of motor vehicles. Never within our time has there accrued so much railroad obsolescence and deferred maintenance as has been caused by the reductions of capital and maintenance expenditures during the last three years. Never have the railways been confronted with competition requiring such changes in their facilities to enable them to hold and recover their passenger and freight traffic. In view of these plain facts, it would appear that a revival of general business is certain to cause a very large increase for some years to come in the business of the railway supply and equipment companies, and that their greatest problem and, also, their greatest opportunity will be to show the inventive genius and initiative necessary to enable them to provide the railways with the improved equipment and other facilities required to enable the railways adequately to reduce their operating expenses and, at the same time, adequately to improve their service."

Directory

The following list gives names of Secretaries, dates of next regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—T. L. Burton, Room 2205, 150 Broadway, New York.

Allied Railway Supply Association.—F. W. Venton, Crane Company, Chicago.

American Railway Association.—Division V.—Mechanical.—V. R. Hawthorn, 59 East Van Buren street, Chicago.

Division V.—Equipment Painting Section.—V. R. Hawthorn, Chicago.

Division VI.—Purchase and Stores.—W. J. Farrell, 30 Vesey street, New York.

Division I.—Safety Section.—J. C. Caviston, 30 Vesey street, New York.

Division VIII.—Car Service Division.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Columet avenue, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

Railroad Division.—Marion B. Richardson, Room 332, 30 Church street, New York.

Machine Shop Practice Division.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

Materials Handling Division.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

Oil and Gas Power Division.—Edgar J. Kates, 1350 Broadway, New York.

Fuels Division.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

Canadian Railway Club.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

Car Department Officers Association.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

Car Foremen's Association of Chicago.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, La Salle Hotel, Chicago, Ill.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth street, Council Bluffs, Iowa. Regular meetings, second Tuesday of each month at Council Bluffs.

Central Railway Club of Buffalo.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month except June, July and August, at Hotel Statler, Buffalo.

Cleveland Railway Club.—F. B. Frericks, 14416 Alder avenue, Cleveland, Ohio. Meetings temporarily suspended.

Eastern Car Foremen's Association.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

Indianapolis Car Inspection Association.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon, 12:15 p. m. for Executive Committee and men interested in the car department.

International Railway Fuel Association.—T. D. Smith, 1660 Old Colony building, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha street, Winona, Minn.

International Railroad Master Blacksmith's Association.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

Master Boilermakers' Association.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September.

New York Railroad Club.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

Northwest Car Men's Association.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

Pacific Railway Club.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately

Railway Car Men's Club of Peoria and Pekin.—C. L. Roberts, R. F. D. 5, Peoria, Ill.

Railway Club of Pittsburgh.—J. D. Conway, 1941 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

Railway Fire Protection Association.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md. Annual meeting October 17-18, Hotel Stevens, Chicago.

Railway Supply Manufacturers' Association.—J. D. Conway, 1841 Oliver buiding, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

Supply Men's Association.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

Toronto Railway Club.—N. A. Walford, district supervisor car service, Canadian National, Toronto, Ont. Meetings first Friday of each month except June, July and August.

Traveling Engineer's Association.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

Western Railway Club.—C. L. Emerson, 822 Straus Building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

NEWS

The Boston & Maine is inquiring for 20 passenger coaches.

The Erie is inquiring for eight combination passenger, baggage and mail cars.

The New York, New Haven & Hartford has issued inquiries for a streamlined train.

The Gulf, Mobile & Northern is inquiring for 50 gondola cars and from 150 to 200 box cars, all of 50 tons' capacity.

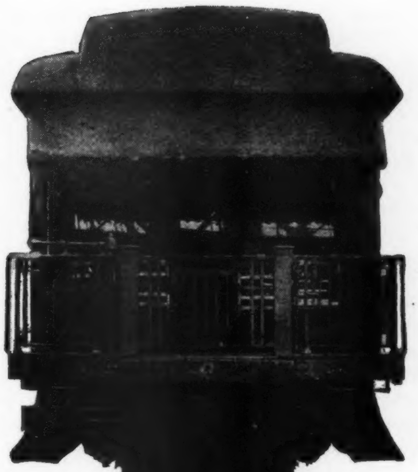
The Cleveland, Cincinnati, Chicago & St. Louis has awarded a contract to the Walsh Construction Company, Chicago, for the renewing of the roof of this company's 35-stall enginehouse at Indianapolis, Ind. This work will involve an expenditure of about $35,000.

The National Railways of Mexico have ordered two 2-6-6-2 simple Mallet type locomotives from the American Locomotive Company. These locomotives, weighing 206,000 lb., will have 15-in. by 22-in. cylinders, a steam pressure of 210 lb., and maximum tractive effort of 41,100 lb.

The Union Pacific has placed an order with the Pullman Car & Manufacturing Corporation for three additional streamlined articulated aluminum passenger trains. One is a six-car train composed of mail and baggage cars, a 56-seat coach and 3 Pullman sleeping cars and propelled by a 900-hp. Diesel engine. The other two are nine-car units, each with mail and baggage cars, coaches and sleeping cars, and propelled by 1,200-hp. Diesel engines.

One Locomotive and 1,879 Freight Cars Placed in Service Last Year

The railroads of the United States placed 1,879 new freight cars in service in 1933, according to reports received by the Car Service Division of the American Railway Association. In 1932, reports showed that 2,968 new freight cars were installed. The railroads on January 1, 1934, had 224 new freight cars on order compared with 2,431 on the same day last year. The railroads placed only one new locomotive in service in 1933 compared with 37 in 1932. Only one new locomotive was on order on January 1, this year, compared with three on the same day last year.



Interest in Air Conditioning Spreading Rapidly

Since the first of the year much interest has been shown in the installation of air-conditioning equipment in various types of passenger cars. The rapidity with which this interest is spreading is evident from the increasing number of orders which have been placed during the past month, as tabulated below. With the consummation of its improvement program, which will involve an expenditure of approximately $1,000,000, including the cost of 18 new all-steel cars, the principal passenger trains of the Norfolk & Western will have been completely air conditioned, while all of its passenger trains, including those assigned to branch-line services, will have been completely equipped with all-steel cars.

Recent Orders for Air-Conditioning Equipment

Road	No. of cars	Type of car	Type of system	Builder
A. T. & S. F.	2*	Cafe-obser.		
	8*	Club	Steam-ejec.	Safety Car Htg. & Ltg. Co.
	17*	Pull. obser.-sleep.		
	13*	Pull. sleeper		
C. & O.	4	Imp. lounge	Mech.	P. C. & M. C.
C. & N. W.	2	Obser.-sleep.	Ice	
	2	Limousine-parlor	Ice	
	2	Lounge-obser.	Mech.	
	1	Sleeper	Mech.	P. C. & M. C.
	1	Obser.-sleep.	Mech.	
	1	Obser.	Mech.	
	2	Club	Mech.	
	10	Dining		To be installed in company shops
	2	Obser.-cafe-lounge	Mech.	
	2	Lounge		
N. & W.	4**	Coaches	Steam-ejec.	Safety Car Htg. & Ltg. Co.
	6**	Coaches	Elec.-Mech.	Frigidaire Corp.†
	8**	Comb. pass. & bagg.	Elec.-Mech.	Westinghouse-Sturtevant†
	43	Coaches	....	....
	19	Pull. cars	....	....
	6	Diners	Elec.-Mech.	Frigidaire Corp.†
S. A. L.	2‡	Diners	Mech.	P. C. & M. C.
	1‡	Parlor		
Union Pac.	22	Obser.	Mech.	P. C. & M. C.
	16	Diners		

* These are in addition to the 26 cars reported in the February issue.

** These are new all-steel cars, an order for which has recently been placed with the Bethlehem Steel Company. They will have a length over-all of 84 ft. 2¾ in., 4 ft. longer than N. & W. coaches now in use. They will have women's and men's lounges, deep-cushioned, double-spring, rotating seats, indirect lighting and other conveniences. The coaches will have a seating capacity of 60 passengers—44 in the main body of the car, six in the women's lounge and ten in the men's lounge. The combination passenger and baggage cars, with a seating capacity of 29, will be similarly equipped.

† Safety axle-driven power plants.

‡ These are in addition to the 15 cars reported in the February issue.

P. W. A. Loans to Railroads

In view of the exhausted status of the public works fund, the Public Works Administration on February 23 announced a policy of hereafter considering for allotment only projects of public bodies and railroads subject to the interstate commerce act. The P.W.A. will continue to make loans to railroads for the purchase of rails and for equipment because of the semi-public nature of the carriers, it announced, and because loans of this character are considered particularly desirable because they are quickly transformed into payrolls and are an important factor in the program to afford relief to the heavy industries. Although the $3,300,000,000 fund has been allotted, from time to time there remains a small unallotted balance due to revocations, withdrawals and reductions and funds thus returned are at once allotted for expenditure elsewhere.

Public Works Administrator Harold L. Ickes announced on March 1, that he had signed two more contracts for railroad loans totalling $2,693,000. This puts under contract $136,889,000 of the $196,607,800 allotted by the P. W. A. for railroad loans. Contracts covering the balance of the fund are in course of preparation.

Since the publication of the February *Railway Mechanical Engineer* the following contracts, allotments or changes have been made:

Chesapeake & Ohio.—The loan to this road for the purchase of the equipment as listed in the January issue has been

reduced from $18,290,000 to $16,876,000.

Boston & Maine.—The program just announced by this road, details concerning which have been under discussion for some weeks, totals $7,318,000, of which $3,719,000 will be expended for the purchase and repair of equipment as follows: Three 800-hp. Diesel-electric passenger units, each capable of hauling four trailers, a Diesel-electric switching locomotive, five Mountain type locomotives for both freight and passenger service, five Pacific type locomotives for passenger service; 10 de luxe air-conditioned passenger coaches, and 21 modern suburban coaches—total, $2,628,000; and for repairs to equipment, including the air-conditioning of the de luxe passenger coaches and diners on several of its principal passenger trains and the installation of de luxe-type reclining seats in 10 passenger coaches—$910,000. The latter amount also provides for the continuation at Billerica of repair work on locomotives, box and coal cars and passenger which was begun in December.

Chicago, Milwaukee, St. Paul & Pacific.—This road has applied to the Interstate Commerce Commission for the necessary authorizations for a loan of $5,720,000 for the purchase of equipment, for which no allotment had yet been announced by the P. W. A., and also for another loan of $2,917,383 to take the place of its previous application for $1,818,750 for rails and fastenings which had been withdrawn. The company applied for authority to assume obligation and liability in respect of equipment trust certificates for 25 all-steel baggage-express cars at an estimated cost of $456,000; 50 all-steel passenger coaches, equipped for air-conditioning, $1,260,000; and 30 high-speed 4-8-4 type locomotives, $4,004,000. Prices have been asked on the 30 locomotives. The additional loan of $2,917,383 for which application was filed with the P. W. A. on January 24 is for the purchase of 20,000 tons of rails, together with fastenings and accessories, $2,066,852; strengthening bridges and lengthening turntables and engine stalls to accommodate the new locomotives, $600,000; air-conditioning 22 dining and lounge cars, $136,000; and the purchase of 300 Evans auto-loaders, $114,531. The previous application had been for the purchase of 50,000 tons of rails.

Delaware, Lackawanna & Western.—$4,666,000 has been alloted to this road and will be used for the following new equipment and rebuilding programs: The purchase of 20 locomotives of the 4-8-4 type, 5 oil-electric locomotives, and 500 steel hopper cars. In connection with the latter separate bids are being requested on cars of 50 tons' capacity and on others of 70 tons' capacity. Inquiry is also being made on the new locomotives.

The rebuilding program calls for converting 986 wood-sheathed box cars into all-steel cars and converting 20 road engines into switching engines. The schedule of work calls for turning out 100 rebuilt box cars and 1 rebuilt locomotive per month.

Erie.—The loan of $11,964,000 to this road, as noted in the January issue, has been reduced to $11,282,000. The Erie also has asked for authority to issue $623,000 of 10-year serial notes to the P. W. A. for the conversion of 750 gondola cars into hopper cars.

Gulf, Mobile & Northern.—An allotment of $1,000,000 to this road will be used for the purchase of 200 freight cars at an estimated cost of approximately $500,000 and passenger equipment to cost about the same. The passenger equipment, which has not yet been ordered, may be of the new high-speed, streamline type, depending on operating results shown by trains now being tested on several other roads.

Illinois Central.—$7,310,855 of this road's loan will be spent for repairing and overhauling 12,645 freight cars, 184 passenger-train cars, and 148 engines in its own shops. This amount, together with $1,438,145 for rails, makes a total of $8,748,000. A somewhat different list of equipment was given in the January issue, also an allotment of $9,300,000.

Lehigh & New England.—The contract with this road is for a loan of $1,212,000 for the purchase of 500 new freight cars. Orders for this equipment were placed, subject to confirmation after execution of the contract, 100 from the American Car & Foundry Company, 150 from the Pressed Steel Car Company, and 250 from the Magor Car Company.

Lehigh Valley.—This road is inquiring for some 4-8-4 type locomotives. It has applied to the P. W. A. for a loan of $600,000 for the purchase of five locomotives and tenders.

Northern Pacific.—The loan of $1,220,000 to the Northern Pacific is to be used for the purchase of the 10 new locomotives ordered from the Baldwin Locomotive Works, as noted in the January issue. The original allotment to this road for this equipment was $1,252,000.

Pennsylvania.—Orders have been placed with the National Malleable & Steel Castings Company for type B trucks to be used on 250 cars of 50 tons' capacity which the railroad is building in its own shops, and with the Westinghouse Air Brake Company, Wilmerding, Pa., for 7,000 complete sets of the new Schedule "AB" freight car air brake equipment to be used on the 7,000 freight cars to be built by the railroad as part of its recently announced improvement and employment program, financed with a P. W. A. loan.

Seaboard Air Line.—Application has been made for a loan for the purchase of 5 locomotives, 1,000 box cars and 100 phosphate cars.

Southern Pacific.—The program of this road includes the rebuilding, repair and modernization in its own shops of 748 locomotives, 3,811 freight cars and 406 passenger-train cars.

Pittsburgh & West Virginia.—An allotment of $331,000 to the P. & W. Va. is for the purchase of three new heavy freight locomotives of the articulated type. These locomotives were provisionally ordered from the Baldwin Locomotive Works subject to confirmation of a loan contract with the P. W. A. and the approval of the Interstate Commerce Commission.

The original allotments to the C. & O., the Erie and the Northern Pacific were made on the basis of the estimated cost of the equipment, but since then competitive bids were obtained which were lower than the estimated costs.

Applications for loans or allotments not previously mentioned in these columns for the purchase of equipment other than cars and locomotives have been made as follows: Boston & Maine, $2,018,000; Pennsylvania, $3,650,000; New York, Ontario & Western, $235,000; Erie, $2,048,498; Wisconsin Central, $115,000. Of the $4,230,000 allotment to the B. & O., reported in January, $1,500,000 is for the purchase of rail and track fastenings.

Supply Trade Notes

The Westinghouse Air Brake Company will move its New York office, about May 1, from 150 Broadway to the Empire State building, Fifth avenue and Thirty-Third street, New York.

Frank B. MacMillin has been elected president and general manager of the Hydraulic Press Mfg. Company, Mt. Gilead, Ohio; Howard F. MacMillin, vice-president and assistant general manager; and Walter G. Tucker, chairman of the board.

H. H. Linton has been appointed eastern sales representative for the W. N. Thornburgh Manufacturing Company, Cicero, Ill. Mr. Linton's headquarters are in the Grand Central terminal, New York City.

The personnel of the Union Steel Casting Company, Pittsburgh, Pa., a subsidiary of Blaw-Knox Company is now as follows: Jan R. Dunsford, chairman of the board; Frank Cordes, president; D. V. Sherlock, manager; William P. McGervey, Jr., assistant to the president. Sales are handled by Robert H. Cunningham, sales manager; Walter H. Eisenbeis, assistant sales manager; John N. Critchlow and Grant W. Lillie.

Harold B. Ressler, vice-president in charge of sales of Joseph T. Ryerson & Son, Inc., Chicago, has been transferred to New York to take charge of the company's Jersey City plant and will take over the duties of J. A. McNulty, who has resigned as manager of the Jersey City plant.

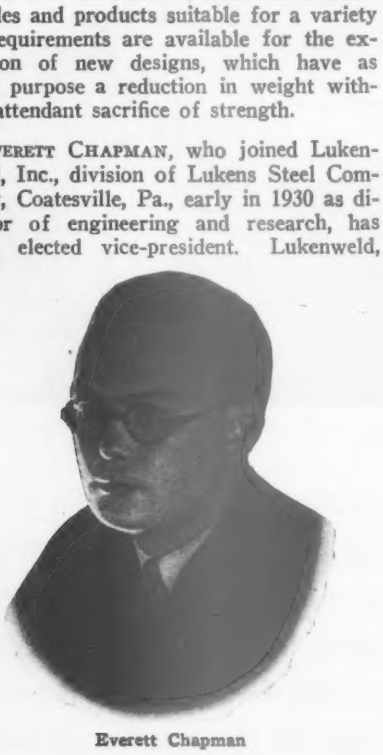
The Ingersoll-Rand Company, New York, has acquired the turbo-blower business of the General Electric Company and will consolidate it with its own turbo-blower department. The manufacturing equipment previously employed by General Electric is being moved to Ingersoll-Rand's Phillipsburg, N. J., plant where all types and sizes will be manufactured. Sales activities will be directed from Ingersoll-Rand Company's general offices at 11 Broadway, New York.

(Turn to next left hand page)

F. STANLEY JONES has been appointed sales manager of wire products, W. H. Messner sales manager of rolled products, and George Tritch assistant manager of sales for the steel division of the Colorado Fuel & Iron Products Company, Denver, Colo.

THE SUBSIDIARY manufacturing companies of the United States Steel Corporation have organized and established a Railroad Research Bureau to engage in developmental work for the benefit of the railroad and railroad supply industries. John A. Ralston is manager of the bureau, which has its headquarters in the Frick building annex, Pittsburgh, Pa. Engineering and experimental work of this department will be closely co-ordinated with the activities of the subsidiary manufacturing companies, in the interest of rendering service to all who are concerned with the application of rolled steel products to the construction of railroad equipment. A series of high tensile steels are being produced and offered to the trade by the companies co-operating in and with the Railroad Research Bureau. Grades and products suitable for a variety of requirements are available for the execution of new designs, which have as their purpose a reduction in weight without attendant sacrifice of strength.

EVERETT CHAPMAN, who joined Lukenweld, Inc., division of Lukens Steel Company, Coatesville, Pa., early in 1930 as director of engineering and research, has been elected vice-president. Lukenweld,



Everett Chapman

Inc., is engaged in the design and manufacture of welded steel assemblies for machinery and equipment. After graduation in 1924 from the University of Michigan, with a master's degree in physics, Mr. Chapman taught electrical engineering at Purdue University, leaving to serve the Lincoln Electric Company of Cleveland, Ohio, on experimental research and development. Since joining Lukenweld, Inc., Mr. Chapman has been credited with responsibility for that organization's engineering achievements in the application of welded steel construction to Diesel engines, presses, planers, lathes, and other machinery and equipment.

PERRY T. EGBERT has been appointed manager of the newly formed Railway Diesel Sales division of the American Locomotive Company with headquarters at 30 Church street, New York. Mr. Egbert will have charge of all sales of Diesel-electric locomotives and of Diesel or gasoline engines for self-propelled rail units and parts therefor. Mr. Egbert started his business career in 1911 as a special apprentice in the Sayre shops of the Lehigh Valley. In 1914 after the completion of this course he occupied various positions with several railroads, leaving the Norfolk & Western in April, 1917, to join the United States Army as an aviator. After being mustered out in July, 1919, he returned to Cornell University, where he received his education, as an instructor in experimental engineering, remaining there until June, 1920, when he entered the employ of the American Locomotive Company in the engineering department at Schenectady, N. Y. Late in the fall of the same year he was transferred to the foreign sales department, and in the spring of 1921 became the representative of the Company in China. Returning to the United States in the fall of 1924, Mr. Egbert became attached to both the domestic sales and manufacturing departments of the American Locomotive Company, with duties confined to the development of new work. Late in 1929, following the acquisition of the McIntosh & Seymour Corporation, the Diesel Engine division of the American Locomotive Company, he was assigned to the McIntosh & Seymour Corporation as the American Locomotive Company representative for the developing of a Diesel engine particularly suited for railway work. Upon the completion of the design he was given full charge of the developing and servicing of the Alco Diesel locomotives, which position he held until his recent appointment. Mr. Egbert, with his new position, will still retain charge of the service bureau.

Obituary

JAMES McLAUGHLIN, district manager of the Franklin Railway Supply Company, Inc., with headquarters at San Francisco,

James McLaughlin

Cal., died in the French hospital, San Francisco, on February 7, after a short illness. Mr. McLaughlin had served in the supply business in the East with the American Locomotive Company for about three years previous to 1913, when he entered the service of the Franklin Railway Supply Company and had taken an active part in the affairs of the A. R. A., Mechanical Division. On April 1, 1921, he was appointed district manager of the Franklin Railway Supply Company, Inc., assigned to the Pacific Coast territory, with headquarters at San Francisco.

EDWARD JAMES KEARNEY, secretary-treasurer of the Kearney & Trecker Corporation, Milwaukee, Wis., died of pneumonia on January 12. Mr. Kearney was 66 years of age at the time of his death.

WINFIELD H. DAVIS, eastern representative of the Spring Packing Corporation, Chicago, with headquarters at Cleveland, Ohio, died in that city on February 4 after a month's illness.

ARTHUR S. LEWIS, district sales manager of the Barco Manufacturing Company, Chicago, with headquarters at New York, died at St. Petersburg, Fla., on February 10.

I. ORVILLE WRIGHT, sales engineer and Baltimore (Md.) representative of The Symington Company, New York, died at the Memorial hospital in Baltimore on January 28 after an illness of several months. Mr. Wright was born at Union Bridge, Md., on March 12, 1872. He attended Quaker and private schools there until the age of 17, when he began work at the Western Maryland shops in that town, spending four years as machinist apprentice. While learning his trade, he attended night school and studied mechanical drawing. He later qualified as a draughtsman for the Western Maryland. In this position he conceived the idea of an improved buffer and attachment for

I. Orville Wright

freight car couplings, and what was later to be known as the Farlow draft gear was invented. In 1899 he served with the South Baltimore Car Works as draughtsman. Shortly afterward, with the help of the late John H. Farlow, then general manager, he marketed his device, giving it the name of Farlow spring draft gear. The Farlow Draft Gear Company was absorbed in 1908 by The T. H. Symington Company. Mr. Wright continued with The T. H. Symington Company and subsequently its successor The Symington Company, up to the time of his death.

Personal Mention

General

Clyde B. Hitch, general master mechanic of the Chesapeake & Ohio at Huntington, W. Va., has been appointed assistant superintendent motive power, with headquarters in the same city, and the position of general master mechanic at that point has been abolished. Mr. Hitch was born on November 4, 1882, at Terre Haute, Ind. After a high school education he entered railway service as a machinist apprentice on the Vandalia Railroad (now part of the P. R. R.) at Terre Haute, completing his apprenticeship in 1900. He later served as machinist on the Pere Marquette, the Louisville & Nashville, the Iron Mountain (now part of Missouri Pacific), the Southern and the Chicago & Eastern Illinois. He entered the service of the Chesapeake & Ohio in 1902 as machinist at Lexington, Ky. He subsequently served from 1910 to 1913 as general foreman of the Covington shops at Covington, Ky., and then in a similar position at the Hinton, W. Va., shops until 1920. From the latter date until 1923, Mr. Hitch was master mechanic at Clifton Forge, Va., then being transferred to the Cincinnati and Northern divisions in the same capacity. He next served as master mechanic of the Cincinnati, Northern and Russell divisions, with headquarters at Russell, Ky., and in May, 1930, was appointed general master mechanic at Huntington, W. Va.

Samuel J. Hungerford, who has been acting president of the Canadian National Railways since the retirement of Sir Henry Thornton as president and chairman in July, 1932, and who has during the intervening period continued to perform the duties of operating vice-president of the properties, has been chosen president of the company.

Mr. Hungerford was born near Bedford, Que., in 1872 and entered railway service

Samuel J. Hungerford

in 1886 as a machinist apprentice on the Southeastern Railway (now Canadian Pacific) at Farnham, Que. Completing his apprenticeship in 1891, he worked at his trade at various places in Quebec, Ontario and Vermont for the Canadian Pacific. In 1894 he became chargeman for the same company at Windsor street, Montreal. Three years later he was promoted to the post of assistant foreman at Farnham shops. In 1900 he went to Megantic, Que., as locomotive foreman. The following year he was transferred to McAdam Junction, N. B., as general foreman. He then went to British Columbia for two years, being locomotive foreman at Cranbrook. In 1903-04 he was master mechanic for the Western division of the Canadian Pacific with headquarters at Calgary, Alta., and in the latter year was promoted to the superintendency of the locomotive shops as Winnipeg, Man. From 1908 to 1910 he was superintendent of shops at Winnipeg. In 1910 he resigned from the service of the Canadian Pacific to become superintendent of rolling stock of the Canadian Northern (one of the predecessor companies of the present Canadian National) with headquarters at Winnipeg. In 1915 he was transferred to Toronto, Ont., in the same capacity. Two years later he became general manager of the Eastern lines of the Canadian Northern and in the following year was appointed assistant vice-president of operation, maintenance and construction of the Canadian National, then in process of formation as successor to the Canadian Northern, with the same headquarters. In 1920 he became vice-president of operation, maintenance and construction of the Canadian National and Grand Trunk Pacific. In 1922 he was appointed vice-president and general manager of the two companies and, upon their merger into the present Canadian National System in 1923, he became vice-president of operation and construction of the system with headquarters at Montreal, in which position he remained until he was chosen also as acting president of the system in 1932.

Master Mechanics and Road Foremen

J. M. Nicholson, master mechanic of the Atchison, Topeka & Santa Fe at Slaton, Tex., has been transferred to Argentine, Kan., to succeed W. R. Harrison.

W. P. Hartman, fuel supervisor of the Atchison, Topeka & Santa Fe at Amarillo, Tex., has been appointed master mechanic of the Slaton division, with headquarters at Slaton, Tex.

Car Department

U. L. Sweeney has been appointed general supervisor car department of the Richmond, Fredericksburg & Potomac.

Shop and Enginehouse

William R. Harrison, master mechanic on the Atchison, Topeka & Santa Fe, at Argentine, Kan., has been appointed superintendent of shops at Albuquerque, N. M.

F. B. Harman, shop superintendent of the Atchison, Topeka & Santa Fe, has been transferred to San Bernardino, Cal.

Purchasing and Stores

William S. Morehead, assistant general storekeeper of the Illinois Central, has been promoted to general storekeeper, with headquarters as before at Chicago.

W. A. Clem, assistant purchasing agent of the Reading, has had his jurisdiction extended to include the Central of New Jersey. Mr. Clem's headquarters are at Philadelphia, Pa.

Obituary

William Davidson, general storekeeper of the Illinois Central, with headquarters at Chicago, died suddenly of a heart attack on February 22.

Evan H. Wade, who retired in 1927 as assistant superintendent of motive power of the Chicago & North Western, died on February 16 at the West Suburban hospital at Chicago at the age of 64 years.

William A. Hopkins, who was general purchasing agent of the Missouri Pacific Lines until his appointment as consulting purchasing agent on September 1, 1933, died at the Missouri Pacific Hospital at St. Louis, Mo., on January 7.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Machinability of Steel.—The effect of cold drawing and the results of annealing are discussed in a four-page folder entitled "Making Steel Machinable" issued by the Union Drawn Steel Company, Massillon, Ohio.

Triple-A No. 44 Aluminum.—The Quigley Company, 56 West Forty-Fifth street, New York, describes and illustrates in a six-page folder applications of Quigley Triple-A No. 44 black anti-corrosive vehicle for aluminum coatings.

Carboloy Cost-Saving Tools.—In its booklet "Carboloy Cost-Saving Tools" the Carboloy Company, 2481 East Grand Boulevard, Detroit, Mich., suggests applications of Carboloy tools of various types, summarizes savings reported by Carboloy tool users, and illustrates a few representative types of tools made at its Detroit plant.

Ljungstrom Air Preheater.—The Air Preheater Corporation (under management of the Superheater Company), 60 East Forty-Second street, New York, manufacturers of the Ljungstrom continuous regenerative counterflow air-preheater, has issued bulletin No. 933 which illustrates various applications of the Ljungstrom air preheater.

Parker-Kalon Products.—Complete information and technical data relating to the use of various types of screws and nails for making fastenings to sheet metal and steel; to iron, brass and aluminum castings; to Bakelite, slate and other substances; for fastening sheet metal to wood, etc., are contained in the 36-page illustrated catalog issued by the Parker-Kalon Corporation, 200 Varick street, New York.